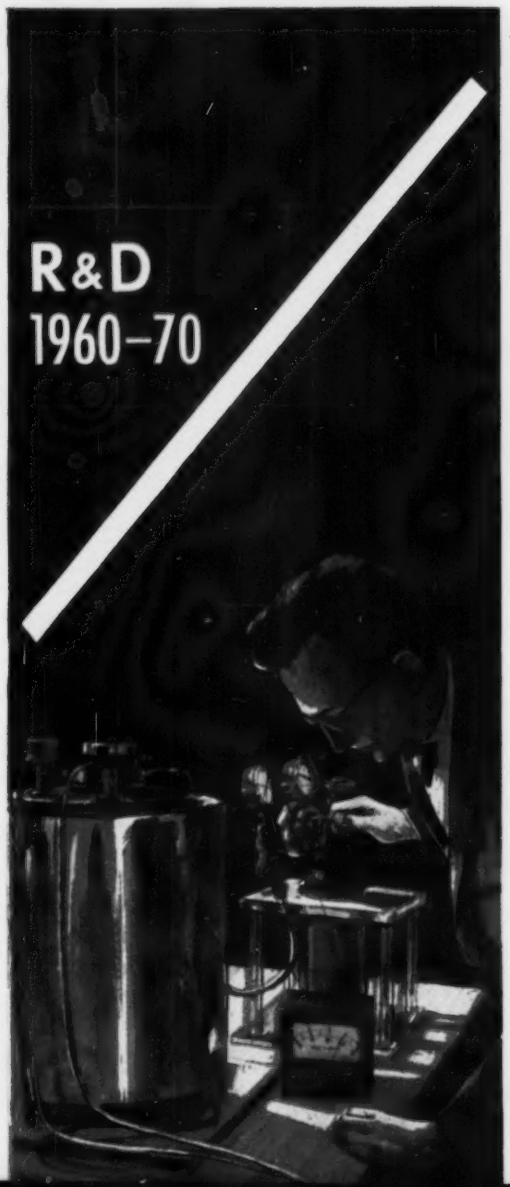
A McGRAW-HILL PUBLICATION MAY 1960
ONE DOLLAR

Power

How research shapes the future of...

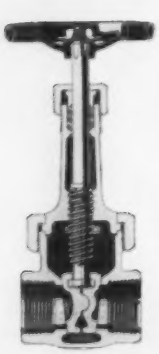


Energy Systems Engineering

a TD report . . . 61

No other 125 lb. Union Bonnet Bronze Gate Valve has all these features

Union Bonnet for extra safety . . . *cylindrical* body design to distribute pressure uniformly and prevent distortion . . . *extra thickness* at points of greatest strain . . . these features *alone* provide the vital margin of superiority over other valves in its class. Together with Stemalloy Stems®, Non-Slip® Handwheels, and many other exclusive features, they actually put this outstanding new valve in a class by itself. You will *see why* when you compare it part-for-part with any other valve designed for similar service. Let your Lunkenheimer Distributor make this comparison for you, or write the Lunkenheimer Company, Cincinnati 14, Ohio.



You Can't Find the Cost of a Valve on a Price List

•BRONZE•IRON•STEEL•PVC®

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-360-85

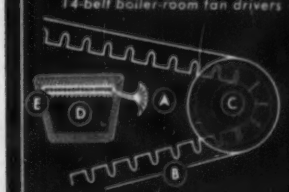
For more facts circle 201 on Reader Service card, p 103

Green Seal belts gave a full year's service where ordinary belts lasted 45 days! Providing longer belt life on this punishing drive proved quite simple to the G.T.M.—Goodyear Technical Man. He merely specified matched sets of 14 COMPASS-V-Steel Belts with the Green Seal for the 4 big boiler-room fan drives at this Southern utility. These steel-muscled belts proved themselves fully capable of the 24-hour-a-day, 7-day-a-week service for approximately eight times longer than ordinary belts. And that was despite a "hot-spot" location right next to the boilers. So this belt user not only saved important money on belt replacements but eliminated a lot of down time as well.

Green Seal, Compass—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

GOODYEAR INDUSTRIAL PRODUCTS GTM-Specified

COMPASS-V-Steel Belts for 14-belt boiler-room fan drivers



A Load-carrying section of endless high-tensile steel cable

B Vents open between pulleys, dissipating heat

C Vents compress rounding pulleys, giving continuous gripping surface

D Highest-quality rubber underbody

E Sturdy bias-laid fabric cover resists wear

All COMPASS-V-Steel Belts are now notched

There's nothing like having an expert handy when you have an industrial rubber problem demanding an S O S solution.

And that's where the G.T.M.—teamed-up with your Goodyear Distributor—really shines. They're not only readily available but are always there with the Hose, Conveyor Belts and other industrial products that do the trick. Just look under "Rubber Goods" or "Rubber Products" in the Yellow Pages. Or write Goodyear, Industrial Products Division, Lincoln 2, Nebraska, or Akron 16, Ohio.

Lots of good things come from

GOODYEAR

THE GREATEST NAME IN RUBBER

For more facts circle 204 on Reader Service card, p 103

speaking of **Power**

Knowing readers' needs for technical information, and getting a closeup picture of their on-the-job responsibilities, are part of this business of publishing an engineering magazine. The more we know about you, the better we can serve you.

We get this information in many ways. It starts the day you subscribe; you then become a candidate for our monthly editorial survey. Some 500 cards are sent out on each issue, asking readers' evaluation of the magazine they pay for. Results are most helpful to the editors. Reader reaction to individual advertisements is also checked via another survey technique. Simultaneously, our research people are hard at work studying the engineering habits and responsibilities of POWER subscribers.

Last year our researchers completed an extensive survey covering the equipment responsibilities of readers in the broad industrial electrical area. Readers were asked pertinent questions about 40 separate products in seven broad categories spread between primary-substation transformers and industrial-lighting fixtures. We found, among other things, that POWER-reader plants in the manufacturing and service areas alone bought $500 million worth of electrical products in the single year under consideration.

Another marketing query recently completed determined our subscribers' responsibilities for heating, air conditioning and refrigeration equipment. Once again excluding consulting engineers and those readers in the public utilities, we came up with total spending for a year in POWER-subscriber plants. Amount: $820 million. This is another measure of the key role of the energy-systems engineer. In both surveys over 80% indicated their responsibilities encompassed energy systems throughout the plant.

Coming next: a close look at subscribers' responsibilities for instrumentation and control. *You* may well be one of the readers surveyed.

Lon Rowley

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"Cheap and dirty" coal...

...a premium performer in the

B&W Cyclone Furnace

Low-cost, unwashed, high-ash coals actually aid efficient combustion in the B&W Cyclone Furnace

Low grade coals are effectively fired in the B&W Cyclone Furnace with a continuous high velocity blast of secondary air, causing a cyclonic turbulence. Ash in the coal is melted to form a viscous fluid bed around the cylindrical furnace walls. This slag bed traps incoming coal on its surface, letting the high velocity secondary air scrub the coal, burning out maximum Btu's. More than 80% of the ash is trapped in this liquid slag and tapped into slag tanks before entering the secondary furnace.

So—the high slagging characteristics of low-cost, unwashed, low-fusion-temperature coals make them an *especially attractive* fuel!

In addition, B&W Cyclone Furnaces offer all of the following advantages:

- **Simplification of coal burning equipment**
- **Less atmospheric pollution**
- **Elimination of fly ash handling and disposal problem by reinjection system as a part of the unit**
- **Less space, smaller building**
- **Less maintenance and cleaning**
- **Safer operation, simpler remote control**
- **Increased availability**

The unit under construction on the left is one of the more than 325 B&W Cyclone Furnaces to be erected to meet the increasing needs for maximum efficiency of energy conversion in the power industry. We would welcome an opportunity to put the advantages of a B&W Cyclone Furnace in *your* language. For further details, please contact your local B&W representative . . . or write for B&W Bulletin G-65. Address: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G-965

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

For more facts circle 205 on Reader Service card, p 103

AT ASHLAND, KY. WORKS OF ARMCO STEEL CORPORATION

"Increased boiler capacity can often be obtained by modernizing boiler cleaning equipment. Another benefit of such modernization is more efficient utilization of the fuel . . . getting more heat into the steam for useful work and wasting less heat up the stack.

For example, at the Ashland, Kentucky Works of the ARMCO Steel Corporation there are four boilers that were unable to supply the growing steam requirements of the plant. The high exit gas temperatures suggested that a study be made to determine whether the cleaning could be improved to provide additional capacity. This study indicated that more steam from the same fuel could be expected if high pressure long retractable blowers were used for cleaning instead of the rotary blowers with which the boilers were originally equipped.

The expected results seemed sufficiently promising and it was decided to modernize the cleaning equipment of one boiler. The seven rotary blowers were replaced with four Diamond Long Retracting Blowers, one of which is shown below. This modernization proved to be justified as the boiler's maximum steam output was increased 11% and the exit gas temperature was reduced approximately 100° F.

A "Boiler Cleaning Modernization Program" is well worth careful consideration because it can mean substantial savings in so many ways. In addition to increased capacity and more efficient fuel utilization, there is reduced maintenance . . . also reduced operating costs when motorized units and automatic operation are installed. Even though your boiler cleaning was the best at the time it was installed, improvements since then will probably pay off. For many years Diamond has been doing continuous research to improve boiler cleaning and boiler cleaning equipment.

Ask the nearest Diamond office (or write directly to Lancaster) to make a study of your boiler cleaning . . . the possible savings may surprise you."

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

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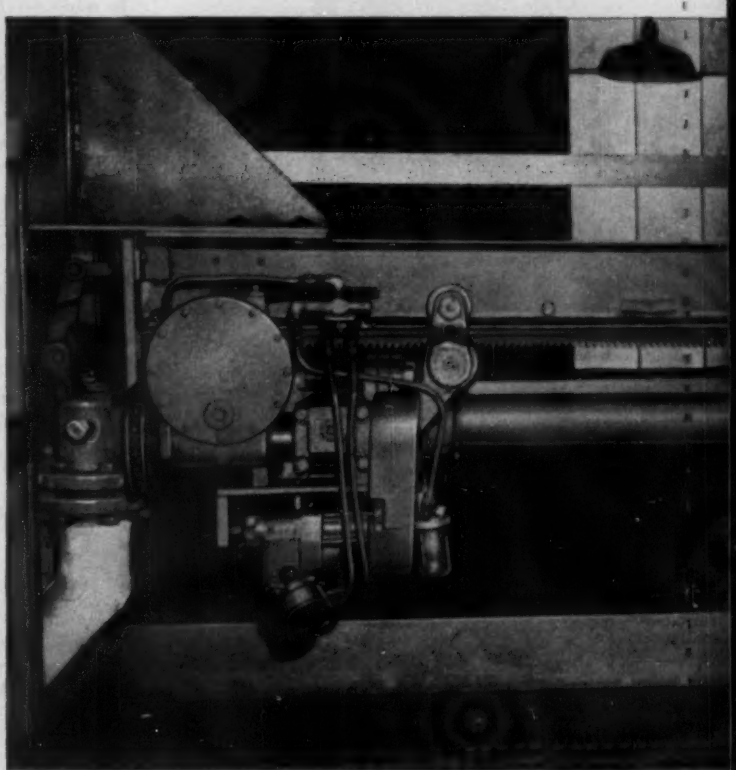
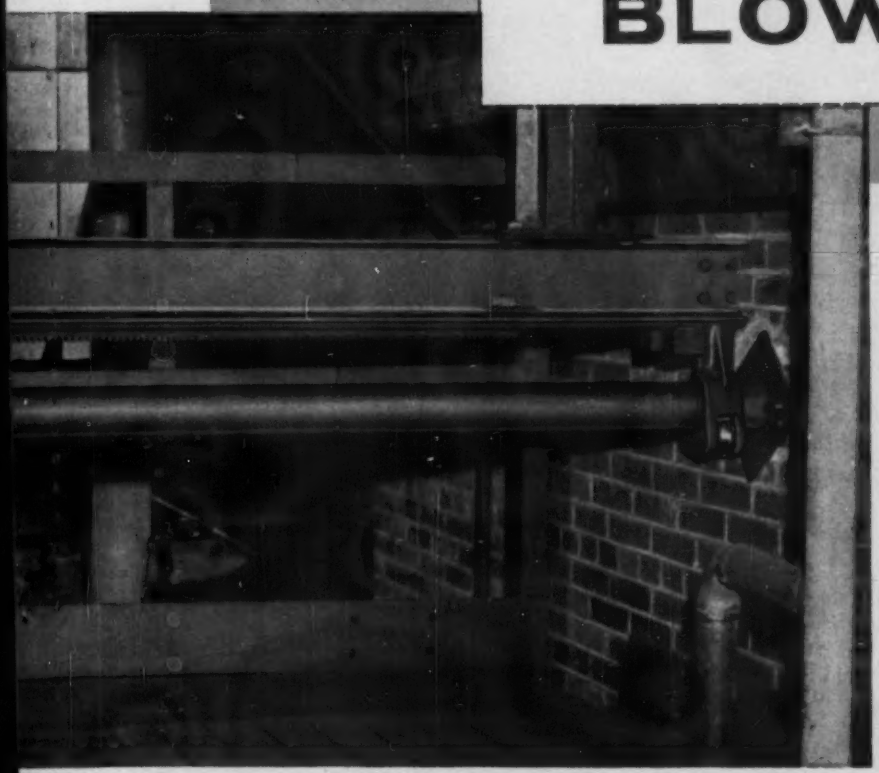


The Mark of
BETTER BOILER CLEANING
AT LOWER COST

11% More Steam 100° F Lower Exit Gas Temperature

RESULT FROM BOILER CLEANING MODERNIZATION PROGRAM

Using DIAMOND LONG RETRACTING BLOWERS



One of the four Diamond Long Retracting Blowers used to modernize the cleaning of the first boiler at the Ashland Works of ARMCO Steel Corporation. The results were so satisfactory that the three other boilers in this plant are now also being modernized.

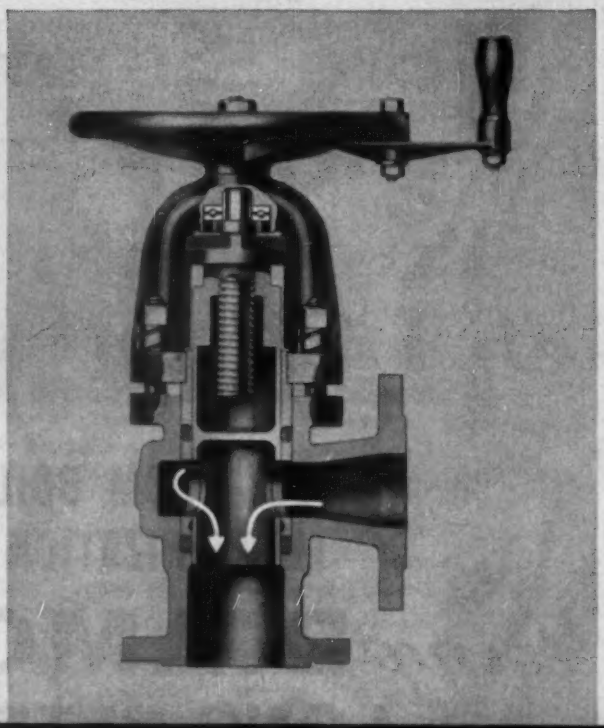
8257

For more facts circle 206 on Reader Service card, p 103

These YARWAY VALVE DESIGNS

YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR [redacted] PRESSURES

USED IN OVER 15,000 BOILER PLANTS

serve every boiler blow-down need

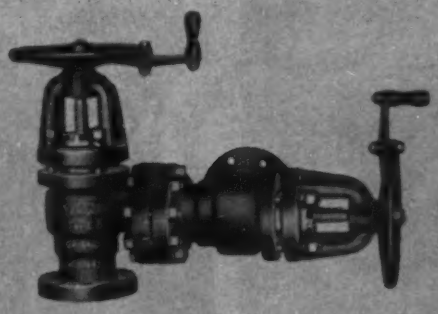
■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

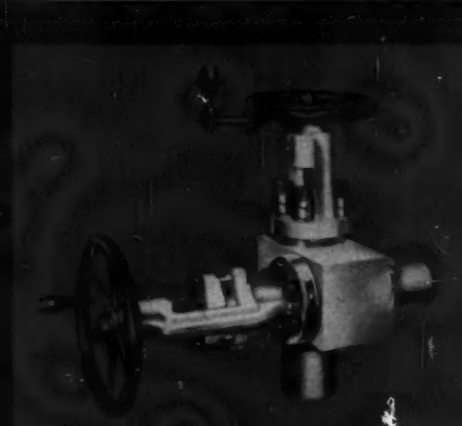
Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

● Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.



● Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

● Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.



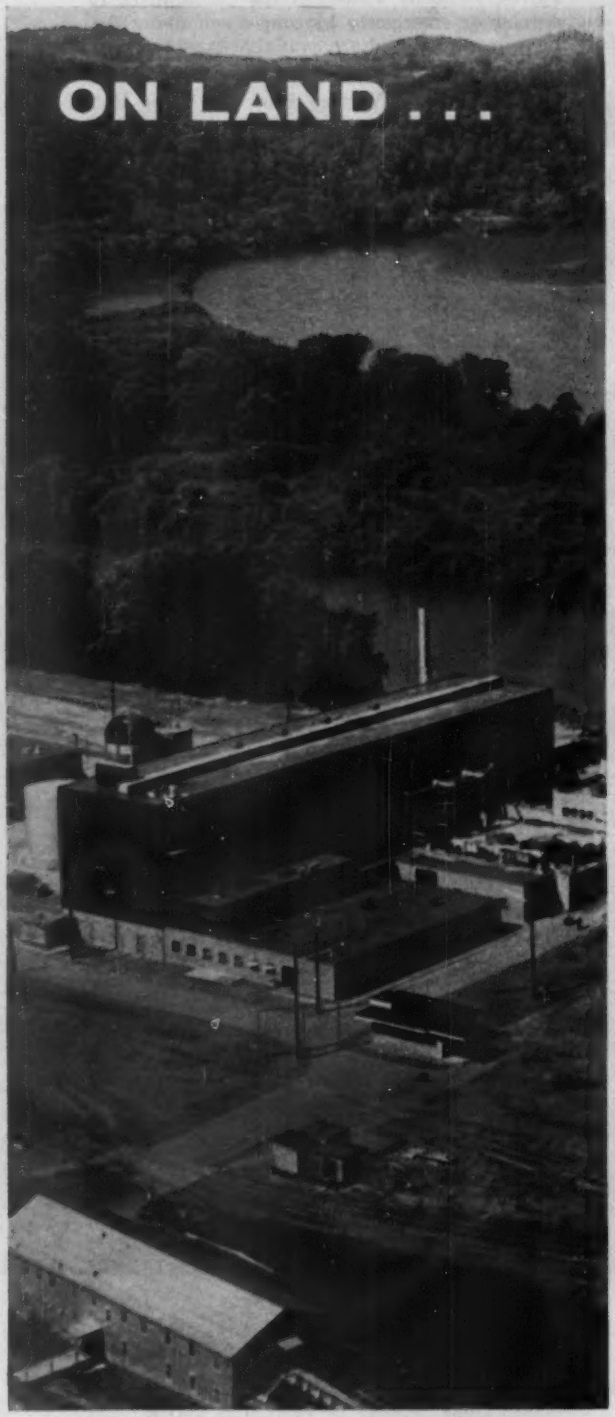
LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

blow-off valves

circle 207 on Reader Service card, p 103

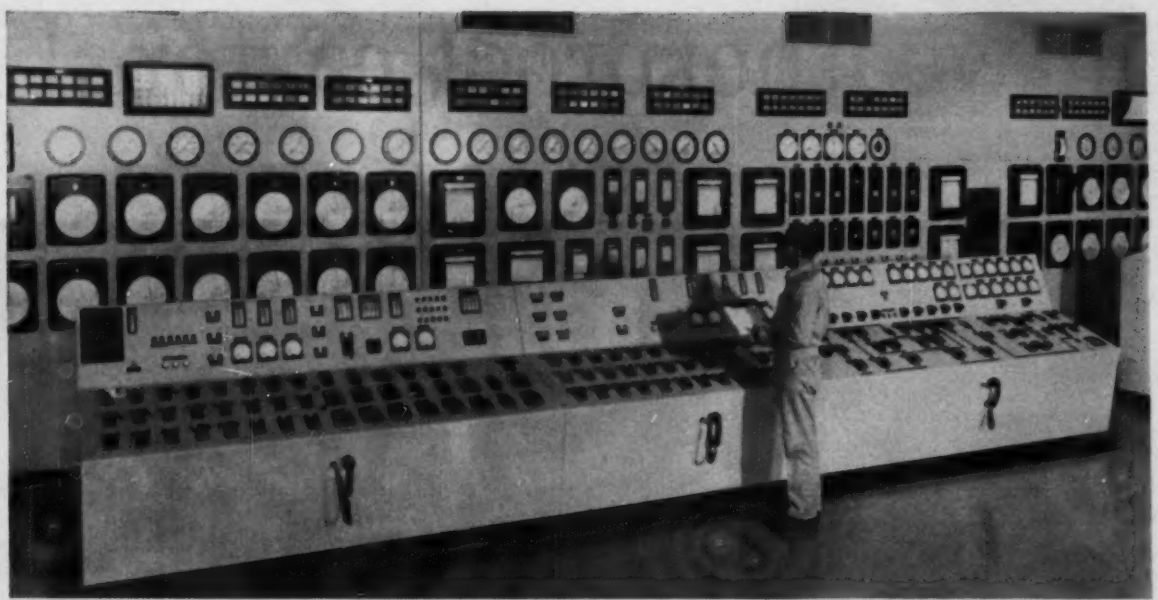


At the Shippingport Station, world's first full-scale atomic, electric power plant devoted exclusively to civilian use, Bailey instruments and controls help to secure full capacity and safety.

Typical of the modern U.S.-Flag tanker fleet using Bailey controls is the ESSO Gettysburg. You'll also find Bailey controls aboard Naval ships, cargo ships and lake steamers.

Bailey meters and controls in centralized control room at Tulsa Power Station, Public Service Company of Oklahoma. In steam-electric generating plants of this kind, Bailey has installed more combustion, feed water and steam temperature controls than have all other makers combined.

IT'S BAILEY...



for the latest and safest instruments and controls for nuclear and conventional power plants!

Many of the power plants of the future will have controls and instruments designed and built by Bailey. There are two reasons: Bailey's continuing research and development toward the latest equipment for industry's needs; Bailey's 40-year association with the hardware and economic requirements of the industry.

If you are planning new or improved power plant facilities, call on Bailey engineers to insure that your system will have the *proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.*

Call on Bailey for primary sensing devices, indicators, loggers, control units, panels, data handling equipment, computers for performance analysis, and supervisory controls. You'll find designs ranging from conventional to the most sophisticated . . . mechanical, pneumatic, electric and electronic, including solid state.

There's a Bailey District Office or Resident Engineer close to you. Check your phone book, or write direct.

A142-2

Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

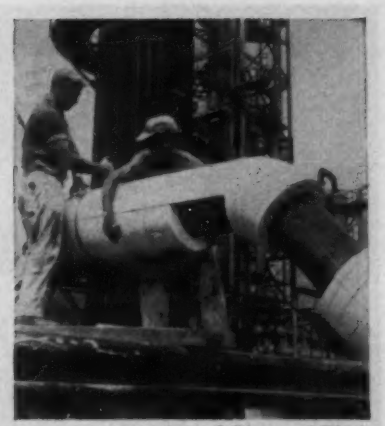
For more facts circle 208 on Reader Service card, p 103

ANOTHER FIRST FROM JOHNS-MANVILLE

Industrial insulations in weatherproof cartons!

All these dollar-saving advantages for pennies more!

- **NO SHEDS TO BUILD**
- **NO HEAVY TARPAULINS TO HANDLE**
- **WEATHERPROOF FOR A MINIMUM OF 3 MONTHS**
- **SAVE TIME, WORK, MONEY ON THE JOB**



J-M THERMOBESTOS® Pipe and Block Insulation for temperatures to 1200 F., light in weight, top mechanical strength, low *k* factor.

Now, thanks to a new and exclusive Johns-Manville carton, you can do away with on-the-job-site storage problems. Never mind the snow and rain. Just put the cartons on runners or skids—*and forget about weather problems.*

These cartons are proved by actual test to withstand rain and snow up to three full months! No need for sheds, lean-tos, tarpaulins or other protection. For only a slight premium, you save time—work—money. And only Johns-Manville offers you this plus value. Ask your J-M Insulation Contract Unit or your nearest J-M sales office.

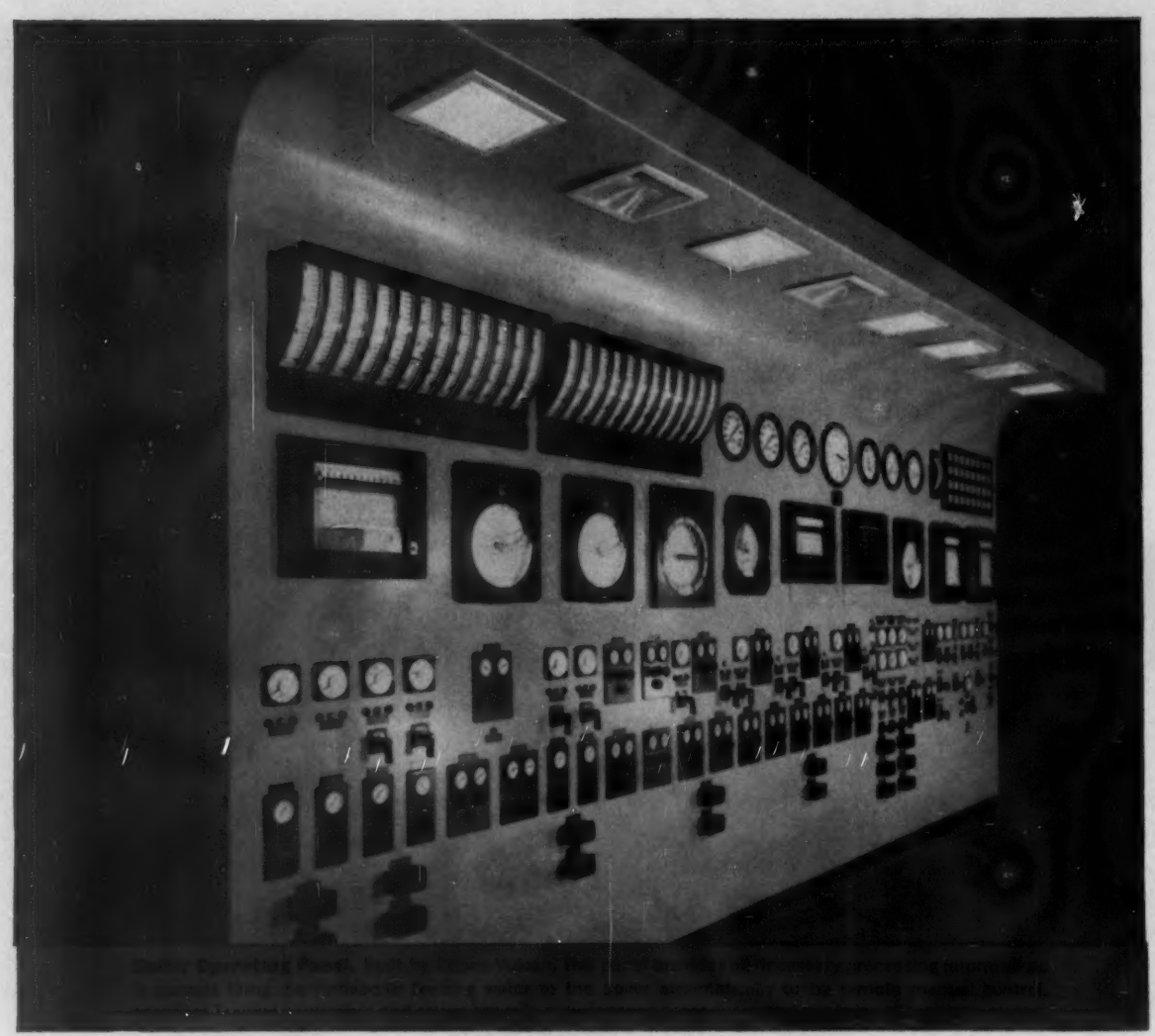
J-M SUPEREX® Block Insulation is furnished in flat or curved blocks, and is recommended for equipment operating at temperatures up to 1900 F.

J-M 85% MAGNESIA Pipe and Block Insulation is designed for use up to 600 F. on heated piping and equipment. The standard for decades.

JOHNS-MANVILLE

JOHNS MANVILLE JM PRODUCTS

AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE



Copes-Vulcan Boiler Control installed at Seward Station

Pennsylvania Electric Company's Seward Station uses an integrated Copes-Vulcan system to provide efficient boiler control. Built to maintain a constant main steam-header pressure under all load conditions, this modern control system provides simplicity of circuits and dependable accuracy of components.

Correcting pressure changes automatically. Fuel feed responds to deviations in steam pressure resulting from changes in steam flow rate, and generates the exact amount of steam to restore header pressure. The system also maintains constant drum level.

Mill temperature control, mill-totalizing circuit and boiler feed pump recirculation control are additional functions of this efficient control system.

Bumpless transfer simplifies operation. All Copes-Vulcan auto-manual stations provide a continuous picture of performance, permit automatic-to-manual selection without the complications of seal balance.

Noted for modern design, high speed response and precision performance, Copes-Vulcan boiler control systems and Vulcan soot blowing systems cut operating costs at modern stations everywhere.

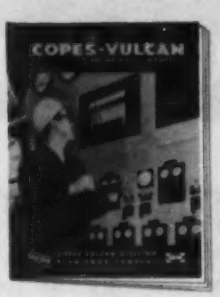
Available in separate units or integrated into a single package, these control systems are custom engineered to meet individual specifications. For details, write Copes-Vulcan Division, Erie 4, Pa.

C-V NEWS NOTES

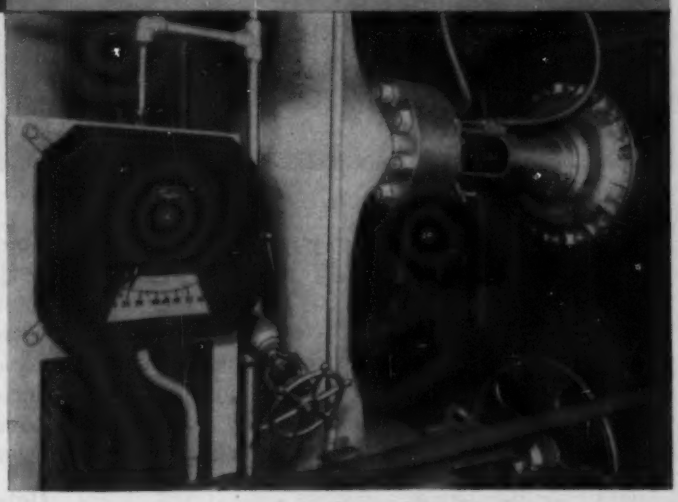
Seward's soot blower system. A Vulcan automatic-sequential control system keeps soot blowers operating in proper sequence. Panel switches permit any soot blower to be cut out of the sequence or reblown if necessary.

Fuel feed drive units. The units shown are typical of all drive units in the control system. A positioner, a four way valve, a power piston and feed-back cam are incorporated into each compact unit.

Pump recirculation control. When discharge from any pump falls below an established limit, an electric-contact low-flow control circuit opens a diaphragm operated by-pass valve to assure sufficient flow to prevent the pump from overheating.



Write for Bulletin 1038. This 12-page bulletin describes in detail Seward's complete control system. Schematic drawings show air-flow and fuel-loading loops. Boiler drawings locate Vulcan soot blowers and wall desiaggers.



Copes-Vulcan Division

BLAW-KNOX

For more facts circle 210 on Reader Service card, p 103

the F/A Motor saves you time and money!

Scheduled inspections and cleanings that result in longer life for your large motors are now easier, less expensive and—for the first time—accomplished with motor parts in *full view!*

The Westinghouse F/A Motor can be prepared for routine inspection, examined, and be back in operation in 10 minutes. For planned yearly inspections, complete disassembly and reassembly take only an hour.

Routine or Weekly Inspection. It takes just three minutes to prepare for this inspection. Merely removing the side panel completely exposes the leads, winding ends and rotor air ducts. A quick cleaning takes care of any contaminants. In four minutes the side panel is back on, and the F/A Motor is in operation.

Detailed Annual Inspection. Such a complete disassembly as is shown at the right, above, is rarely done, because in conventional motors it is virtually impossible. However, with the Westinghouse F/A Motor it *can* be done, and in just half an hour! No other housing design permits such

see-ability and accessibility. Here you can *completely* check windings and bracing, examine the ends of the rotor, check the condition of the *total* core and check all bolts for security. Necessary cleaning can be done in minutes, and with a thoroughness heretofore impossible. Then, in roughly 30 minutes, reassembly of side panels, top air shields, end covers and top enclosure puts the F/A Motor back "on the line."

For full information on the long service life, reliability and accessibility of the Westinghouse F/A Motor, call your Westinghouse representative or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-16009

CHECK THESE BONUS VALUES IN THE F/A MOTOR

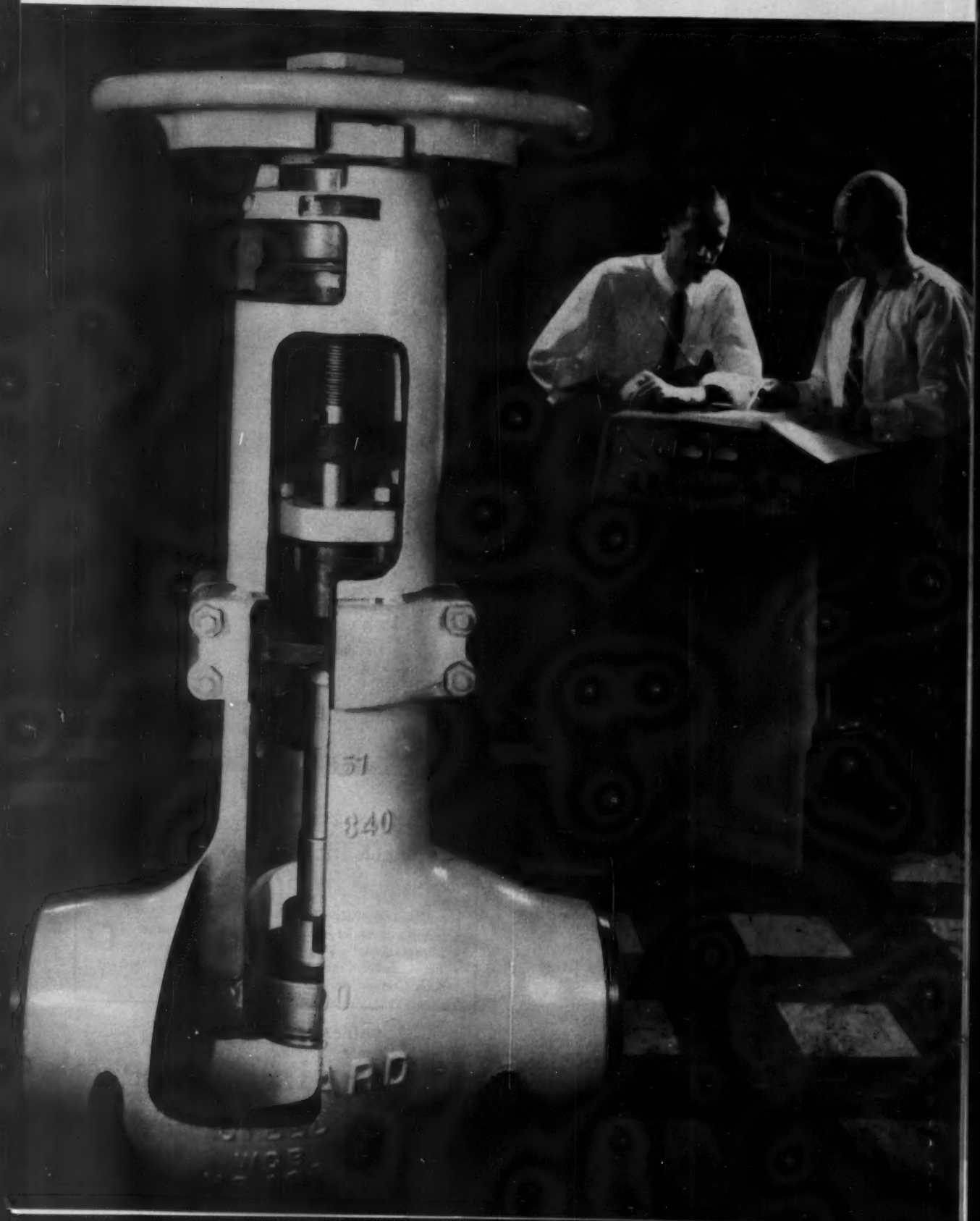
- Full Accessibility
- Inherently Quiet—housing and stator separated
- Thermalastic® Insulation—recognized as the finest
- Time-Proven Components—longer, more efficient life
- Easy Connection—conduit boxes eliminated

YOU CAN BE SURE...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV ALTERNATE FRIDAYS

The Story of Edward Research



and the Pressure-Seal* Valve

The introduction, in 1945, of commercial steel valves with pressure-seal bonnet joint construction was a significant advance in the art of building large high-pressure steel valves. The new pressure-seal construction eliminated massive flanged bonnet joint connections and made it possible to seal the valves permanently at high temperature. These advantages were immediately apparent to users everywhere. But bonnet joint leakage problems developed on the new valves in service. And Edward engineers soon became convinced that the original 45° pressure-seal gasket design used by Edward and others required improvement. Here's the Edward pressure-seal redesign story:

INITIAL TESTING—Edward engineers began their studies on leak problems in 45° gasketed pressure-seal valves by determining under what conditions the valves were most likely to leak. It was discovered that when sealing areas were thoroughly degreased and tested with air, the pressure seal would leak at all pressures above 10 psi. In addition, minute imperfections in the sealing area of the valve body bore were preventing intimate gasket contact and contributing to leakage. Edward engineers found that a broader area of contact between gasket and bonnet and between gasket and body bore would also reduce leakage. Further investigation showed that a gasket plating material softer than the silver plating previously used would be helpful in achieving better contact in the sealing area.

To obtain more gasket sealing area, experiments were conducted on gaskets with angles from 45° down to 17°. Over a period of several months, tests were made with 25 different combinations of gasket and bonnet angles and various gasket plating materials. Assembled valves were tested for tightness with air pressures ranging from 10 psi to 2160 psi, and at temperatures up to 1000 F for extended periods. And tests on ease of valve disassembly (an important user consideration) were made with each gasket combination.

TEST CONCLUSIONS—At the end of their extensive testing program on the pressure-seal design, Edward engineers were able to draw these conclusions:

1. 45° gaskets, which showed no leak on water tests, leaked air at similar pressures.
2. No gasket of any design, either plain or with a plating of 100 Brinell or harder, would seal air when assembled unlubricated.
3. The best sealing under test resulted with a 25° gasket angle which was 1° more acute than the bonnet angle.
4. Gaskets of 25° angle actually tripled the sealing surface area.
5. A stainless inlay in the valve body bore sealing area substantially improved gasket-to-body contact and provided a corrosion-resistant surface.
6. Gaskets of 25° angle, plated properly with a malleable coating, gave perfect air or steam sealing at all temperatures, whether assembled dry or with a lubricant.

NEW VALVE DESIGN—As the result of their tests, Edward engineers designed the completely new pressure-seal valve with 25°-65° joint (see diagram below). This change in gasket angle, with an increase in sealing surface area, and the addition of a special corrosion-resistant malleable coating, brought an end to bonnet joint leakage in Edward pressure-seal valves. And, since 1953, thousands of Edward pressure-seal valves have been installed in a great variety of services *without a single case of failure reported to date.*

The story of Edward research and the pressure-seal valve is typical of the kind of research progress and product leadership you can expect from Edward Valves. Edward builds a complete line of forged and cast steel valves from ½" to 18" for industrial, marine, petroleum and technological services. For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 12. West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

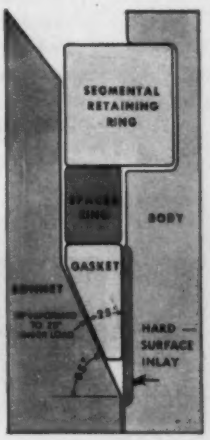
*Patented

EDWARD STEEL VALVES
another fine product by
ROCKWELL

P. J. DUKES, product development engineer, and D. MacGregor, works manager, are shown with helium leak detector used in testing pressure-seal valve joints.

SPECIAL GAS-FIRED FURNACES were used in temperature testing of new pressure-seal valve design. Furnaces heated valves up to 900 F for 24 hour periods. Pressure was maintained with hydro-pneumatic pumps.

NEW 25° GASKET DESIGN



circle 212 on Reader Service card, p 103

sharp

AMERICAN BI-METAL THERMOMETERS make accurate temperature readings sharp and sure at all check points

American Dial Thermometers are also available in mercury, vapor pressure, and gas actuation . . . on-the-spot and distant reading types . . . in sizes, ranges and stem lengths to meet your most exacting requirements.

sensitive

Any way you look at an American Bi-Metal Thermometer, you see exact working temperatures.

The two-level "Maxivision®" dial eliminates parallax effects. Numerals are on the lower level. Graduations are on the outer raised ring dial which presents a sheared edge to the tip of the pointer and in the same plane. To make readability even more accurate, the glass and graduated dial are closely spaced.

American Bi-Metal Thermometers are made of weather-proof stainless steel. All joints are welded to solid unity, then polished smooth so corrosion won't build up and destroy the thermometer's usefulness. And, you don't have to discard this thermometer if even the glass is broken. The bayonet lock bezel makes replacement easy.

Learn about the high sustained accuracy and long service life built into American Bi-Metal Thermometers. Phone your nearby industrial supply distributor for help in selecting the right type for each temperature check point in your plant. Or write for Catalog 100A.

MANNING MAXWELL & MOORE M&M TRADE MARK

AMERICAN INDUSTRIAL THERMOMETERS

A product of

MANNING, MAXWELL & MOORE, INC.

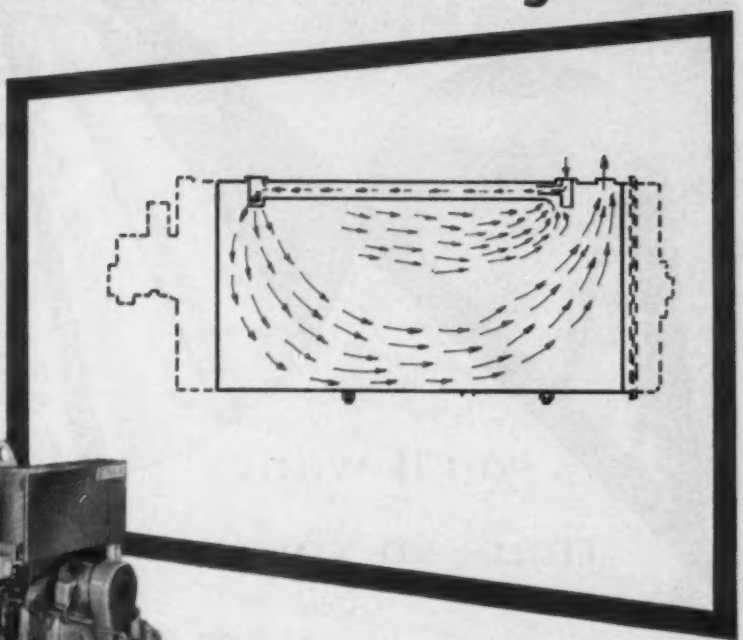
Gauge and Instrument Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

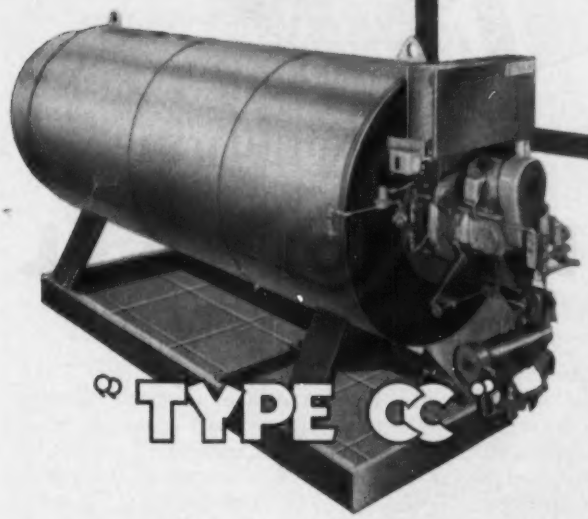
For more facts circle 213 on Reader Service card, p 103

NEW from Superior...

a boiler with Venturi-Action Mixing Tube

for Hot Water Heating





For details of the Type CC, the answer to trouble-free hot water heating, write for Catalog CC-11.

Unequal circulation within the boiler . . . a problem of serious consequence in hot water heating . . . has been overcome by a newly developed *Venturi-Action Mixing Tube* which is an integral feature of the new Type CC. The tube plays a triple role:

(1) It starts by mixing entrained water from the boiler with water entering the boiler.

(2) As this mixture travels through the tube, its temperature is further modified by surrounding water.

(3) Jet action at the end of the tube, where flow is directed down and outward at the boiler front, provides an unequalled full-length boiler circulation pattern.

This flow pattern was carefully traced time and again by means of thermo-couples which proved that the mixing action achieved was unequalled in any other hot water boiler.

Specialists in PACKAGED BOILERS... exclusively

SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
PACKAGED BOILERS

For more facts circle 214 on Reader Service card, p 103

Check these improved
1960 insulations

BEH
BALDWIN-EHRET-HILL

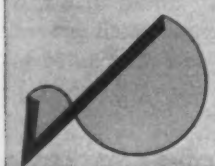
you'll want
them in your new specifications

Take a Fresh Look at **THERMASIL**

Calcium Silicate Insulation

Thermasil now offers more advantages than ever before. Take the matter of strength! The hardness of a calcium silicate should be sufficient to permit safe and easy handling, resist damage from vibration and accidental concussion—yet not be too hard, because low application costs depend on being able to use conventional tools. Only Thermasil has this ideal combination of strength and toughness. And there are other advantages in durability, "hinge strength," freedom from shrinking, warping and cracking.

Continuing product improvement by Baldwin-Ehret-Hill makes it essential to keep your ideas fresh - with timely, accurate knowledge of constantly changing insulation materials. You'll realize that old specifications are of little value in writing new ones for modern installations. Baldwin-Ehret-Hill offers you the complete line—a selection of over thirty specialized insulations for service from sub-zero to 1900 F. To bring your specifications up to date, write for our 1960 catalog or see it in your Sweet's Files.



NOW IS THE TIME TO UPDATE YOUR SPECIFICATIONS WITH . . .

BALDWIN-EHRET-HILL

200 Breunig Ave., Trenton 2, N. J. Incorporated • 1897

THE COMPLETE LINE OF INSULATIONS for use SUB-ZERO TO 1900 F.

CONTRACT APPLICATION SERVICE FROM COAST TO COAST

99.2% AVAILABILITY

provided by Clark Centrifugal Compressor during two years of glass plant service!

Still in "Like New" condition, a Clark Model 2M7 Centrifugal Compressor recently posted an outstanding service record in a glass plant application by logging a total of 16,968 trouble-free hours. Scheduled downtime for maintenance amounted to only 0.84% of availability despite the fact that the compressor was operated for eight months in an atmosphere charged with silica dust before an air filter was installed. But trouble-free service is only the beginning for this dependable Clark compressor, as indicated by the two-year service report at right. For this kind of quality and dependability, contact your Clark representative or write to:

CLARK BROS. CO.
OLEAN, NEW YORK

CLARK

COMPRESSORS • ENGINES • GAS TURBINES

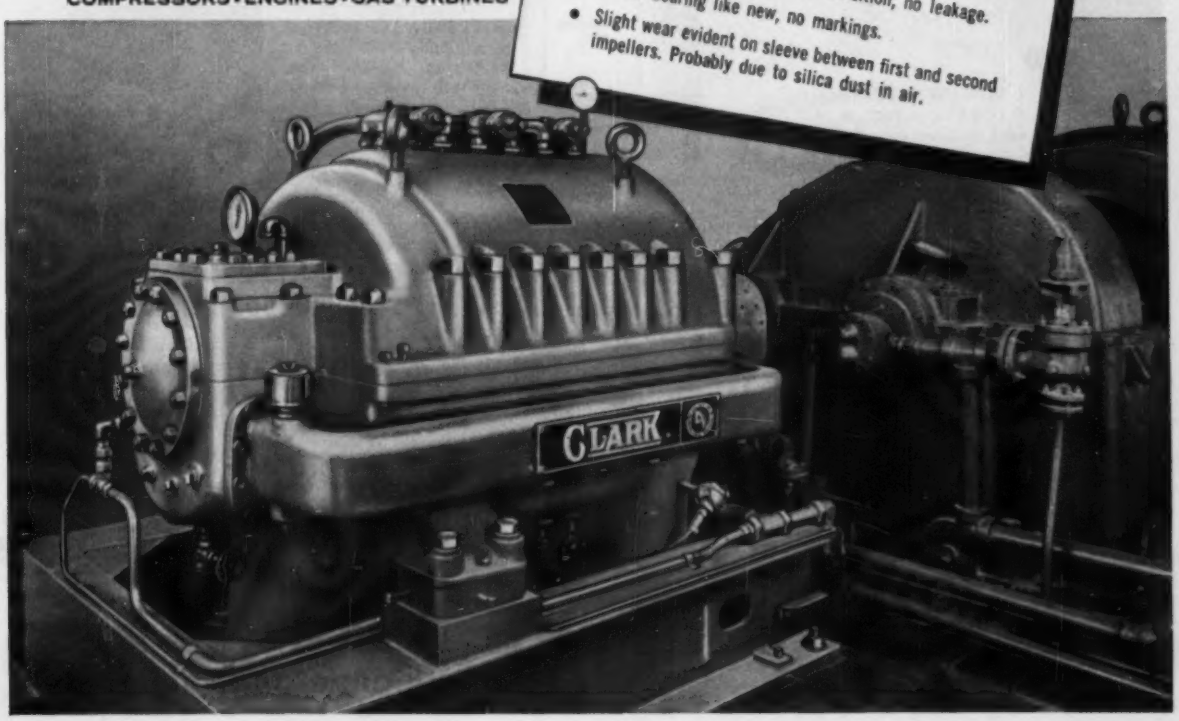
SERVICE REPORT

MODEL—Clark 2M7 Centrifugal Compressor. Horizontally split, down connected, with diaphragm cooling. Rated 1415 bhp. Capacity 7500 cfm. Gear driven by 1200 rpm electric motor.

APPLICATION—Air compressed from 13.36 to 73.36 psia to supply 40% of requirements of nine furnaces producing glass for 1,100,000 bottles daily.

CONDITION OF PARTS—Labyrinths like new, with original knife edge. Clearances well within tolerances.

- Rivets in factory condition, none loose.
- Impeller blades like new, no visible wear on trailing edges.
- Bearings and shaft like new. Slight marks and spots, otherwise polished factory finish.
- Original oil still in machine in clear, clean condition.
- Discharge impeller (seventh stage), no bluing or heat effects evident.
- Discharge seals in excellent condition, no leakage.
- Thrust bearing like new, no markings.
- Slight wear evident on sleeve between first and second impellers. Probably due to silica dust in air.

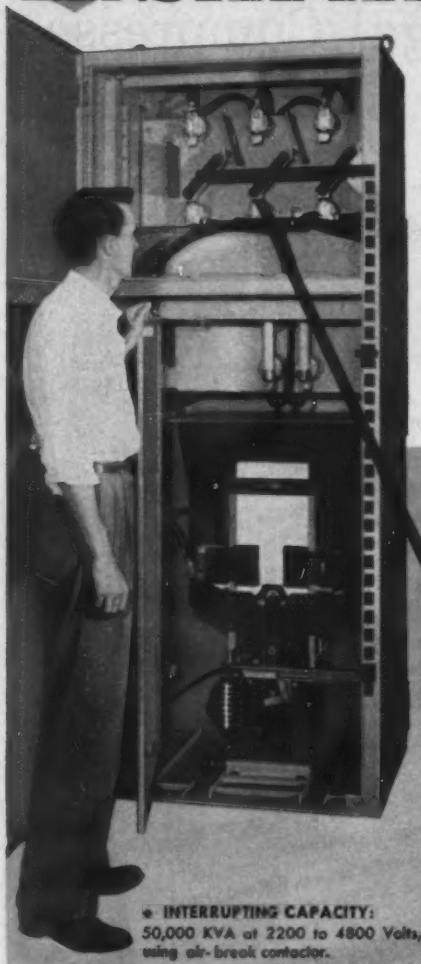


For more facts circle 216 on Reader Service card, p 103

For those who think twice about

TWO E-M MOTOR CONTROL LINES

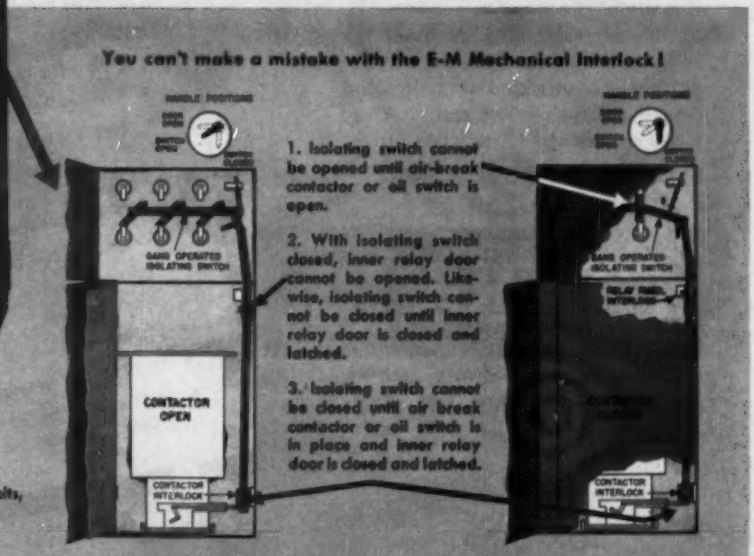
E-M SAFAIR Magnetic Control (NEMA CLASS E-1)



• INTERRUPTING CAPACITY: 50,000 KVA at 2200 to 4800 Volts, using air-break contactor.

Compare these features with those of your present controls

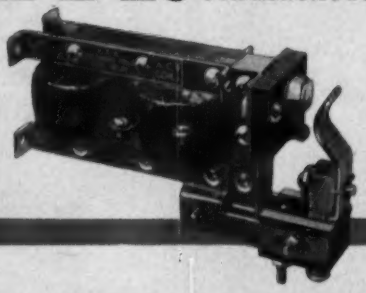
1. **Complete Personnel Safety** with a foolproof system of mechanical interlocking between gang-operated isolating switch, oil switch or air-break contactor, and compartment doors.
2. **Complete Motor And Control Protection.** Skillfully engineered and applied components are carefully coordinated to protect both motor and control over complete design range of overload and fault conditions.


You can't make a mistake with the E-M Mechanical Interlock!
1. Isolating switch cannot be opened until air-break contactor or oil switch is open.
2. With isolating switch closed, inner relay door cannot be opened. Likewise, isolating switch cannot be closed until inner relay door is closed and latched.
3. Isolating switch cannot be closed until air break contactor or oil switch is in place and inner relay door is closed and latched.
CONTACTOR OPEN
CONTACTOR INTERLOCK

E-M SAFETY-GANG ISOLATING SWITCH of SAFAIR Control is externally operated, internally interlocked as detailed in color and diagrams above, right.

SAFAIR features a 50,000 kva (NEMA Class E-1 maximum rating) air-break contactor suitable for repetitive motor starting and rapid switching in a complete line of squirrel-cage and wound-rotor induction motor controls and synchronous motor controls.

PFR* for Simple, Reliable SYNCHRONOUS MOTOR CONTROL



Safair- and Safuse-controlled synchronous motors pull into step smoothly and powerfully every time. E-M-invented *Polarized Field Frequency Relay system of synchronous motor

3300-TPA-2189

ELECTRIC MACHINERY

Originators of the safety-gang

their men and motors...

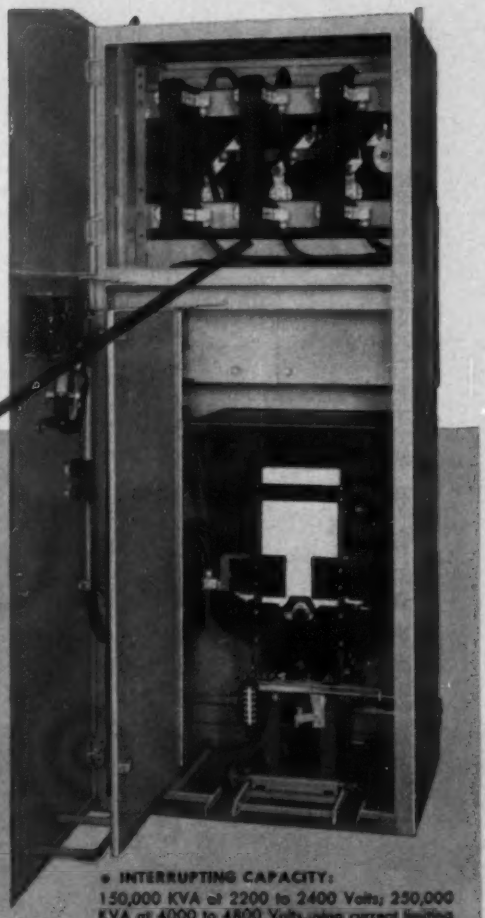
OFFER COMPLETE PROTECTION!

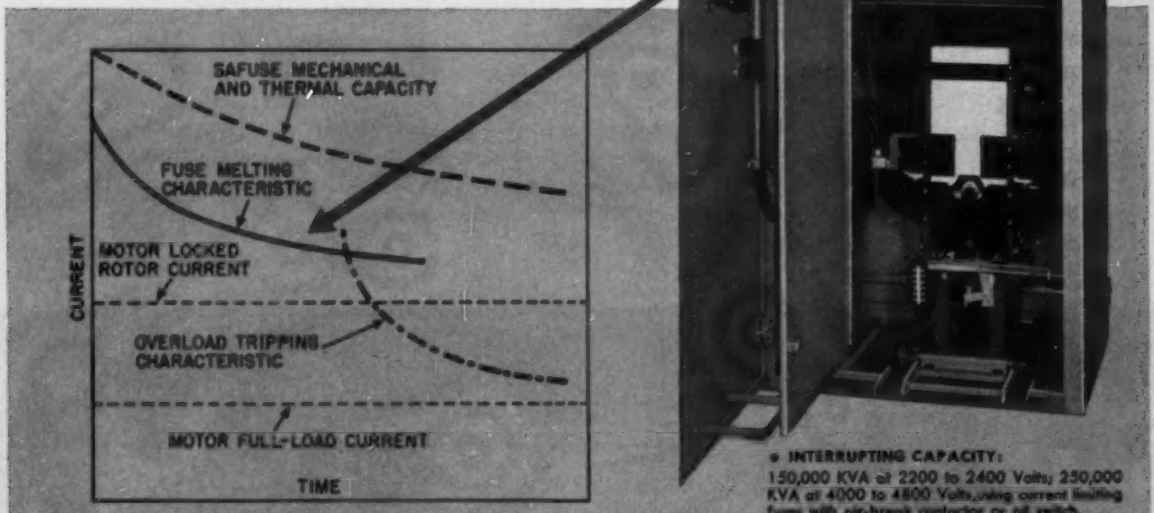
E-M SAFUSE Magnetic Control (NEMA CLASS E-2)

3 Complete Front Accessibility. Controls may be placed in rows, back-to-back or back-to-wall—no access required to back or sides.

4 Complete Space Utilization. Imaginative E-M engineering has provided a highly compact control design without compromise on safety or performance, and with provision to accommodate modifications.

5 Complete Modification Line. You can tailor the control to fit your exacting requirements—nearly 100 options and special features available.





starting and synchronizing is sensitive to the electrical condition of the field winding, applying field excitation at proper rotor angle for maximum synchronizing torque with minimum current inrush . . . and it's coupled with E-M's modern field failure protective system.

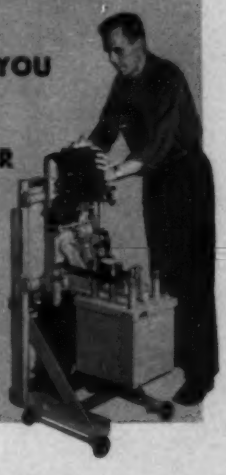
FAST ACTING FUSES *plus* E-M Safety-Gang Isolating Switch in SAFUSE are the best possible combination for complete motor and control protection thru NEMA Class E-2 maximum ratings. The current limiting fuses provide short circuit protection and are carefully coordinated with overload relays as shown in diagram above.

Complete information and helpful application data are available from your E-M Field Engineer. Call him and write the factory for publications 242A and 249.

* INTERRUPTING CAPACITY: 150,000 KVA at 2200 to 2400 Volts; 250,000 KVA at 4000 to 4800 Volts, using current limiting fuses with air-break contactor or oil switch.

SAFUSE GIVES YOU CHOICE OF AIR-BREAK CONTACTOR OR OIL SWITCH

For highly repetitive duty use the roll-out air break contactor. But for less frequent starting—or in areas of severe dust, dirt, moisture, or corrosive fumes—the roll-out oil switch is recommended.



E-M MFG. COMPANY MINNEAPOLIS 13, MINNESOTA

disconnect high-voltage fused control

For more facts circle 217 on Reader Service card, p 103

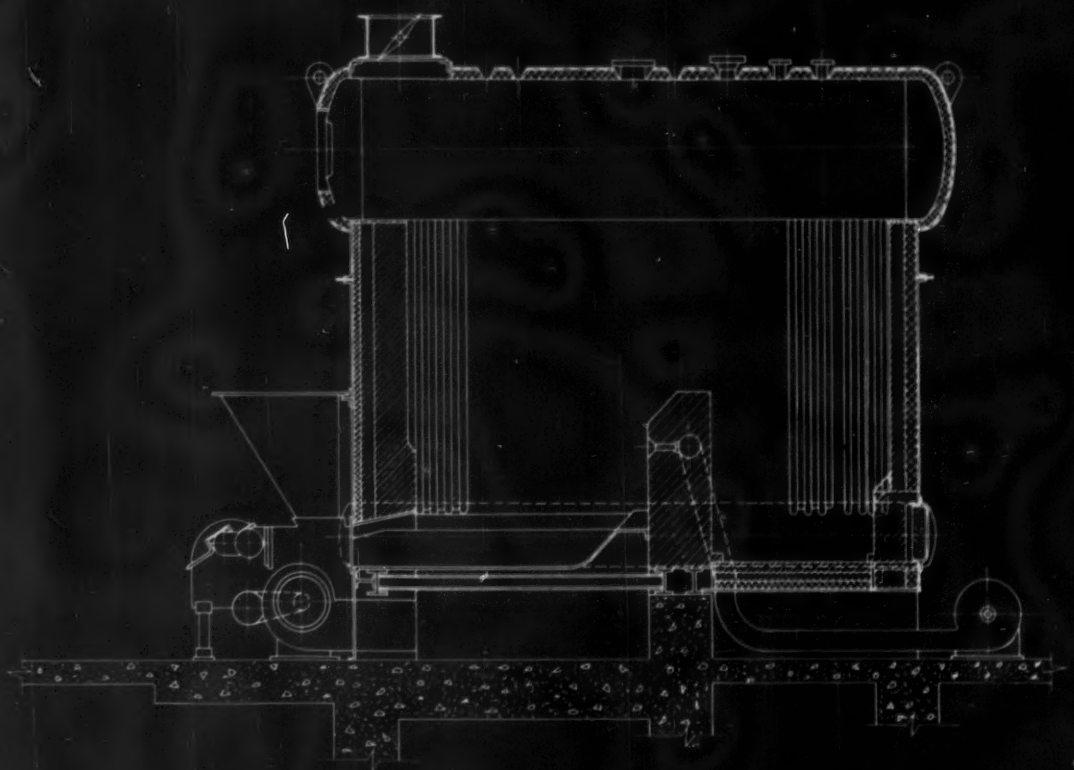
you can take full advantage of the fuel situation with

WICKES

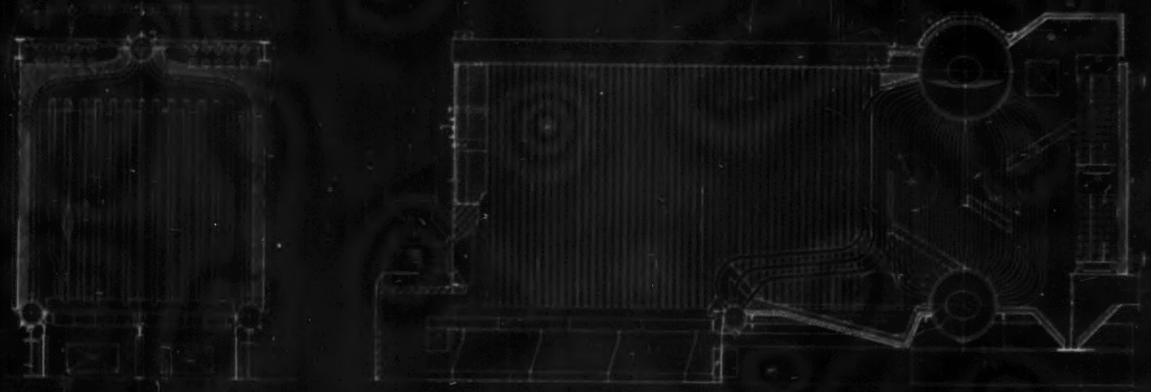
PACKAGE STOKER-FIRED STEAM GENERATORS

Designed and built to WICKES recognized standard of excellence, engineered to WICKES high standard of efficiency

These stoker-fired WICKES generators are compact, package water tube boilers, custom-engineered to your exact steam generating requirements. Semi-automatic in operation and convertible from stoker-fired to either gas or oil fired, these WICKES generators are built to the highest standards of workmanship to give you the same efficiency of operation that you have come to expect from all WICKES-built boilers. They are built in a variety of designs to meet size, space and fuel conditions. For complete information on these WICKES stoker-fired units as well as the complete line of WICKES water tube steam generators, ask the WICKES sales representative nearest you to call . . . offices in principal cities*.



TYPE A



TYPE S-3

TYPE A

WICKES

BOILER CO., SAGINAW 10, MICHIGAN

RECOGNIZED QUALITY SINCE 1854

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DIVISION OF THE WICKES CORPORATION

For more facts circle 218 on Reader Service card, p 103

See why ALCOA ALUMINUM makes a good design habit

Requirement: Low-cost, corrosion-resistant heat exchanger material

Key to Good Design: Specify Alcoa Aluminum Tube and Sheet

If corrosion resistance, long life, product purity and economy are considerations in your heat exchanger application, specify aluminum! ALCOA® Aluminum has been solving such problems for over 40 years.

In the petroleum industry, ALCOA Aluminum Tubes serve in main column overhead condensers where their freedom from fouling and excellent heat transfer properties have made them a natural selection. Heat exchangers made of ALCOA Aluminum Tube and Plate are used in the production of ammonia, nitric acid, vegetable oils, naval stores, naphthalene, hydrogen peroxide, oxygen and urea. These and other processes call for heat exchangers with combinations of high strength, excellent sub-zero physical qualities, high thermal conductivity, or nontoxic and noncatalytic properties. ALCOA Aluminum alloys meet all these requirements.

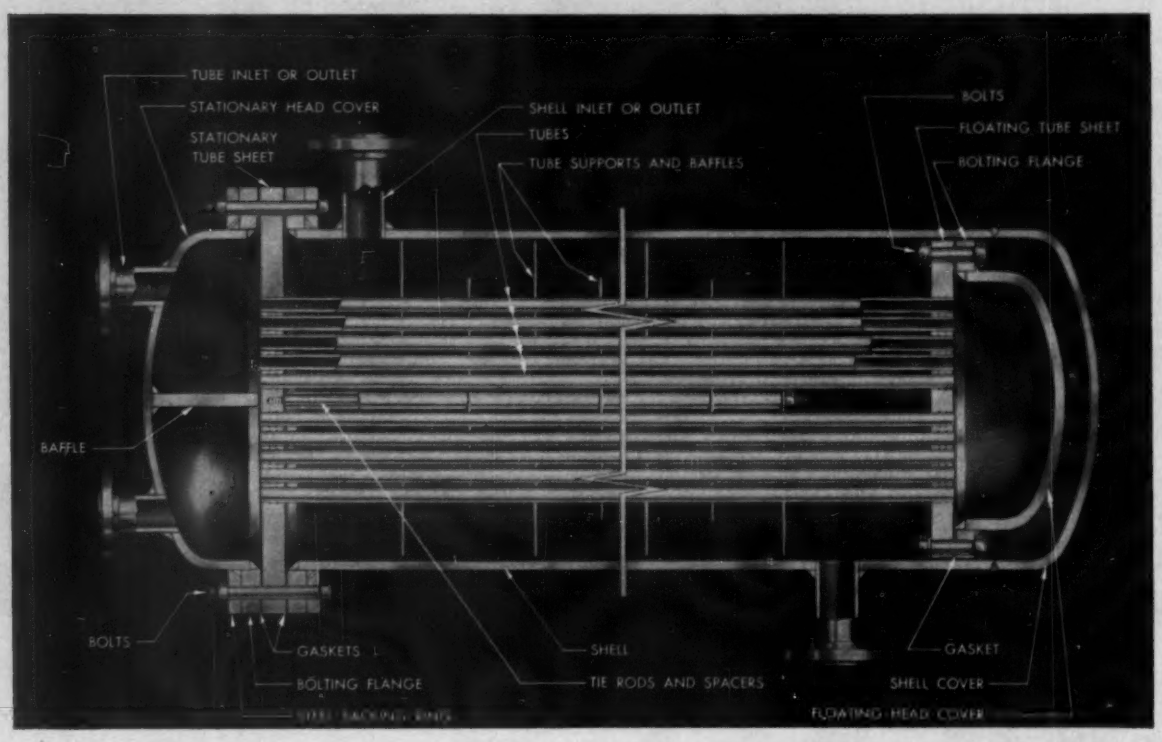
As for cost, ALCOA Aluminum Tube is the most inexpensive. In the common sizes it costs one-third less than mild steel, one-half as much as admiralty, and one-fifth that of stainless.

ALCOA Aluminum alloys are ideally suited to a wide range of maintenance methods. For relatively soft or loose scale, water jets and brushes are usually satisfactory. Wet sandblasting as well as chemical cleaners may be used effectively.

ALCOA engineers have worked closely with all segments of the process industries for over 40 years, and can help you specify the aluminum alloy best suited to your heat exchanger and other process applications. ALCOA's unparalleled experience in this field is available to you for the asking. Write to the address on the coupon, stating your requirements as specifically as possible. ALCOA's development engineers will welcome the opportunity to work with you on your problems.

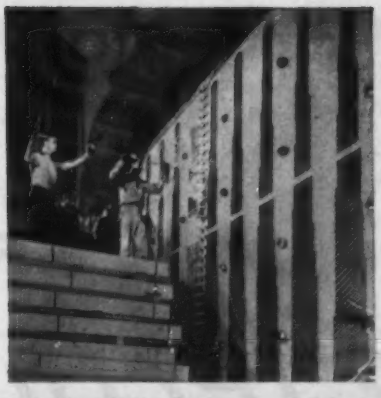
You can also take advantage of the wide selection of free ALCOA literature on aluminum for heat exchangers and other process applications. Simply check the booklets you want on the coupon and mail to the address indicated. ALCOA will forward your material promptly and without obligation.

ALCOA is conducting a series of engineering conferences on process industries applications of aluminum during 1960 in a number of major cities. Contact your nearest ALCOA sales office for full particulars and dates.



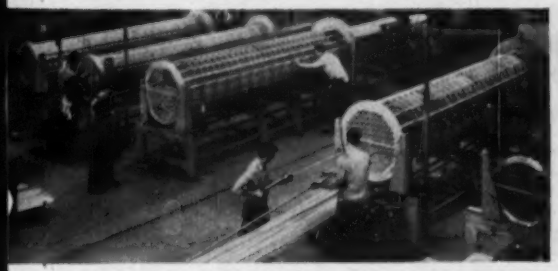
For certain processes where corrosive or sensitive materials are involved, it is often advisable to use aluminum for entire heat exchanger systems to avoid system corrosion and contamination of the product. A typical all-aluminum heat exchanger is shown here. Alloy recommendations are given in the table opposite.

Alcoa Aluminum Tubing protects color in the world's largest rotary steam-tube drier. The drier measures 10 ft in diameter by 100 ft long.

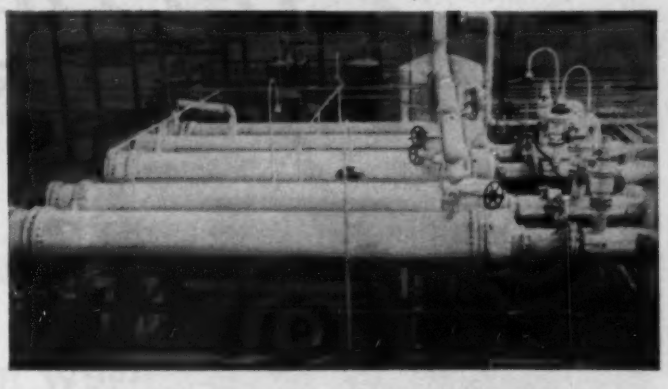


A Midwest utility saved 50 per cent on tubing costs by using Alcoa Aluminum instead of admiralty for tubing in this surface condenser. Successful operation of this unit has led to the installation of similar units by other utilities. This use demonstrates aluminum's economy and superior resistance to ammonia, carbon dioxide and hydrogen sulfide.

A battery of all-aluminum heat exchangers in a polyethylene plant. Selected for initial low cost, these aluminum exchangers provide freedom from product contamination as well as desirable low temperature properties.



Construction of a heat exchanger utilizing Alcoa Aluminum Tube. Superior working properties plus the cold-drawing method by which Alcoa seamless heat exchanger tubes are produced results in close dimensional tolerances and smooth inside and outside surfaces.

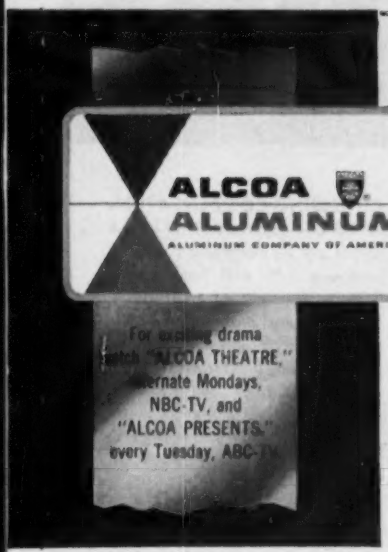


This all-aluminum dephlegmator in a large coke plant is used for the regeneration of ammonia liquor in a hydrogen sulfide scrubbing operation. Aluminum tubes lasted five times longer than steel tubes in a similar use.

Alloy Recommendations for Aluminum Heat Exchanger Construction

	Alcoa Designation	ASTM Specification*	Alloy
Tubes	3003-H14	B234	M1A
	Alclad (inside) 3003-H14	B234	clad M1A
	Alclad (outside) 3003-H14		clad M1A
	Alclad (both sides) 3003-H14		clad M1A
	6061-T6	B234	GS11A
	6062-T6	B234	GS11C
Tube Sheets	3004-H112	B178	MG11A
	Alclad 3004-H112	B178	clad MG11A
	6061-T6	B178	GS11A
	Alclad 6061-T6	B178	clad GS11A
Baffles	3003-H14	B178	M1A
	Alclad 3003-H14	B178	clad M1A
Tie Rods	6061-T6	B273	GS11A
Shells & Headers	3003-H112	B178	M1A
	Alclad 3003-H112	B178	clad M1A
	3004-H112	B178	MG11A
	5052-H112	B178	GR20A
	5154-H112	B178	GR40A
Fittings	3003-F	B274	M1A as applicable
	6061-T6	B274	GS11A as applicable
Flanges	6061-T6	B247	GS11A as applicable

*Only the basic number is shown since Alcoa products are manufactured to the latest issue of the specification. The complete number would indicate the year of issue.



Aluminum Company of America
868-E Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature covering Alcoa Aluminum in heat exchanger and other applications in the process industries.

- ☐ 10186 Alcoa Aluminum Heat Exchanger Tubes
- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 20272 Aluminum Alloys for Handling High Purity Water
- ☐ 20268 Resistance of Aluminum Alloys to Fresh Waters
- ☐ 20935 Designing to Prevent Corrosion

Name_____

Company_____

Title_____

Address_____

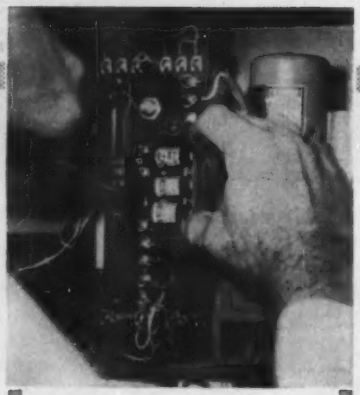
City_____

State_____

For more facts circle 219 on Reader Service card, p 103

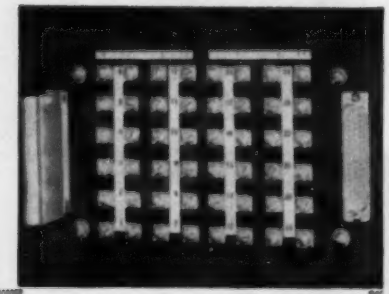
Record 2 to 24 points on the same

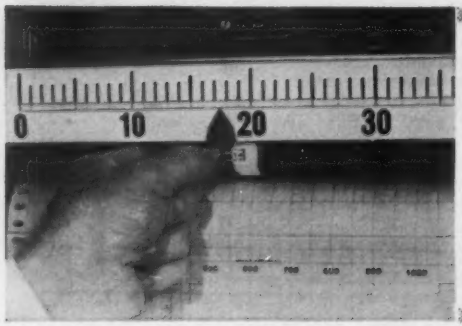
UNIVERSAL Electronik RECORDER



CHANGING RANGE IS EASY—Loosen screws and slide out the range resistor card. Replace with a different card, tighten screws and the job is done quickly and easily.

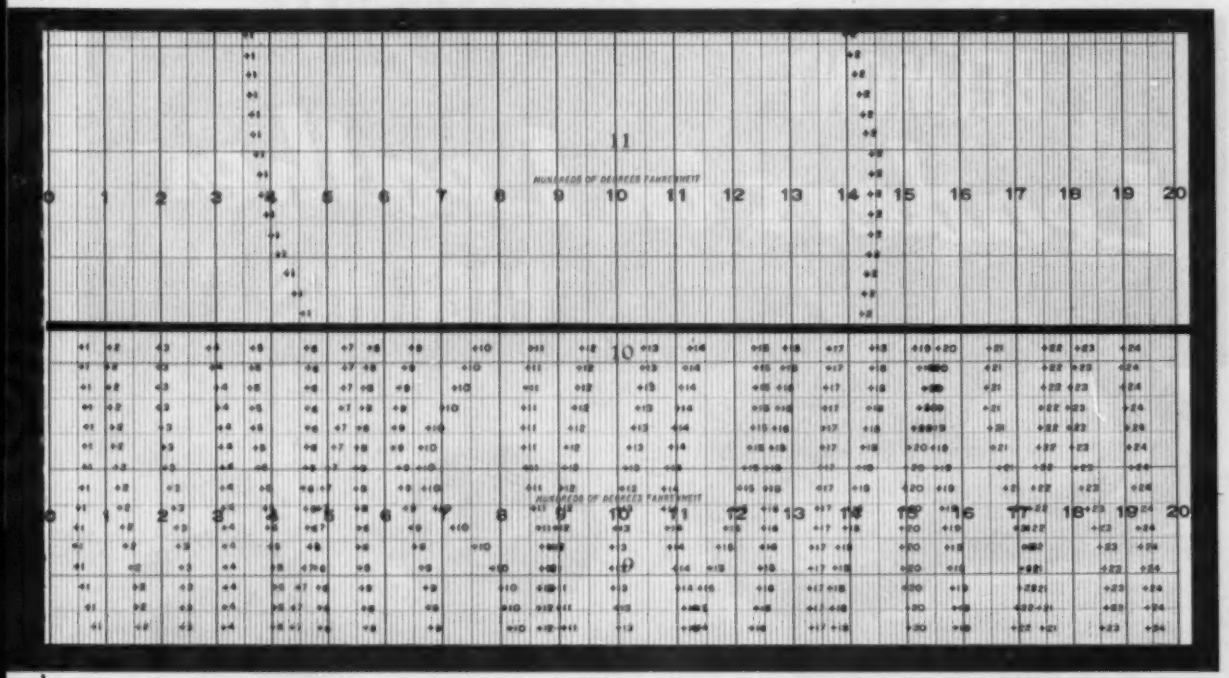
New modular design . . . and greater value than ever





CHANGING NUMBER OF POINTS IS EASY—First, remove thumb-tight nut; slip off print wheel and indicator dial. Slip on new wheel and dial and replace nut. Second, replace one plug-in unit on extreme right of terminal board, and the instrument is ready to record any desired number of points.

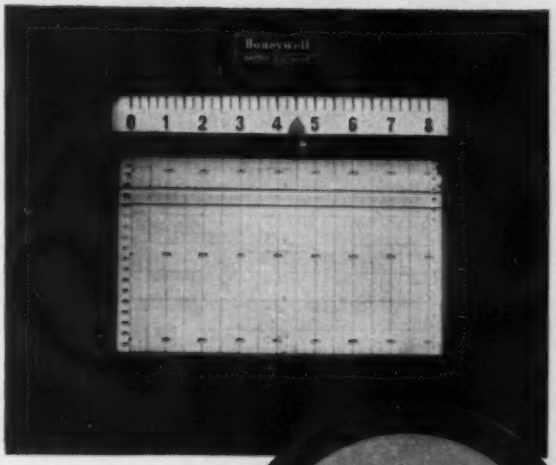
CHANGING COMPENSATION IS EASY—Input terminal board comes out by removing one plug (extreme left) and four screws. Slide in the new board, replace the screws and plug and the compensation is changed. Reference junction is built into terminal board on reverse side.

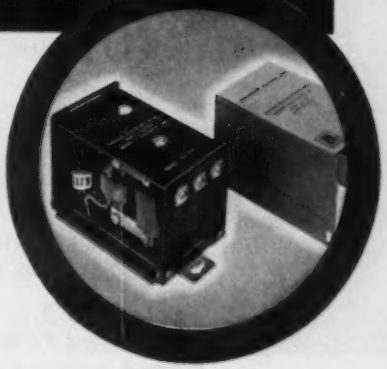


Now, you can record 2,3,4,6,8,10,12,16,20 or 24 points on one instrument—the new Universal *ElectroniK* Recorder. And you can change the number of points to be recorded in a matter of seconds. It's as easy as this: remove a thumb-tight nut and slip off the old print wheel and indicator dial. Slip on a new wheel and dial and replace the nut. Plug in the number of points wanted, and the job is done.

New modular design makes all *ElectroniK* instruments easier to use and maintain and a greater value than ever. This new design has also resulted in substantial manufacturing economies and appropriate price reductions. Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.





CONSTANT VOLTAGE UNIT (Zener diode) eliminates batteries, standard cells, and standardizing mechanisms.

Honeywell

First in Control

SINCE 1885

75th YEAR PIONEERING THE FUTURE

For more facts circle 220 on Reader Service card, p 103

BELMONT
Leaders in Leather
PACKINGS

If you require leather packings—cups, V-packings, U-packings, flanges, gaskets, washers—in your maintenance program, consider what Belmont offers you in quality, completeness of line, service for the emergency, convenient availability and competitive prices

UNLIMITED ASSORTMENT

Belmont Leather Packings meet the requirements of all makes of hydraulic and pneumatic equipment. For example, V-Packings and Cups range in size from 99" down to 5/16" O.D., with hundreds of die combinations for all intermediate dimensions.

FAST DELIVERY

. . . a matter of days from receipt of order. Available through hundreds of strategically located Belmont Industrial Distributors throughout the U.S.A. and Canada. Air delivery from factory in emergencies.

A SEPARATE COMPLETE PLANT

Devoted exclusively to advanced techniques in leather packing manufacture. Backed by a quarter-century of experience in this specialized field.

FROM FIRE-SAFE HYDRAULIC FLUIDS TO AIR

Belmont Leather Packings are supplied untreated or impregnated with Rubbers, Plastics or Waxes to meet requirements of modern usage on all media including fire-safe hydraulic fluids, oils, oxygen service, foodstuffs, water, water-oil emulsions, lubricated or dry air.

•

Buy from the Leaders in Leather. Buy Belmont. See Conover Mast Purchasing Directory for Belmont Distributor nearest you.

The Belmont Packing & Rubber Company
Butler & Sepviva Streets, Philadelphia 37, Pa.

BELMONT

For more facts circle 221 on Reader Service card, p 103

circle 222 on Reader Service card, p 103 ➤

BJ Quality Pumps for every service!

Pumps

Twelve thousand horsepower—directly from the main turbine-generator shaft—drives this BJ Boiler Feed Pump for Consolidated Edison's Astoria Unit #3. The first of four similar installations, this 3600 rpm pump delivers 6330 gpm, against a 6400 foot head.

The reliability demanded by such a continuous drive arrangement illustrates the trend towards more critical applications of centrifugal pumps, and of BJ's ability to meet these requirements.

From this giant, to the standard BJ Bilton model below, Byron Jackson can provide *the* quality pump for any service.

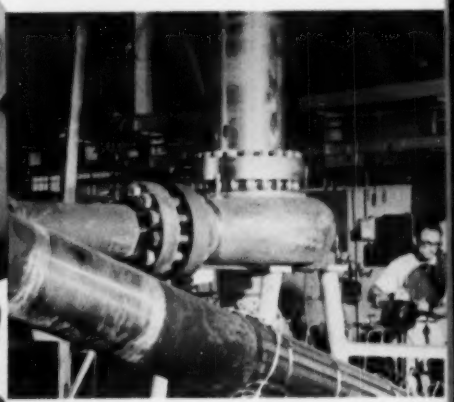
BJ

since 1872

Quality

HYDRAULIC TESTING puts BJ pumps through their paces before delivery...assures each design will perform as specified. Here, a BJ Vertical Circulating Pump is tested in BJ's newly enlarged test lab, which can handle pumps requiring horsepowers to 12,000, venturi capacities to 70,000 gpm.

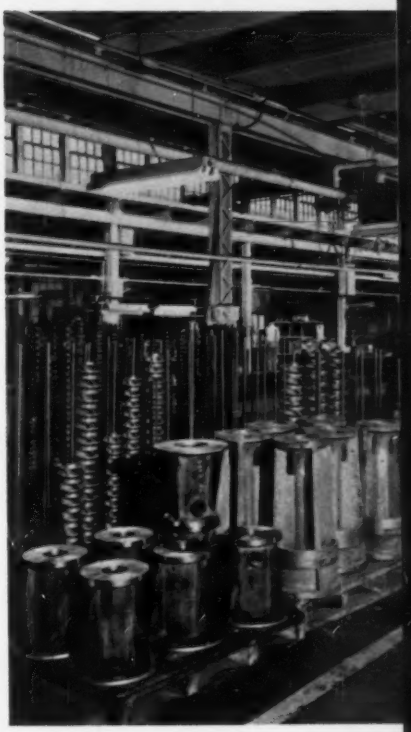
SPECIAL TESTING such as this continuous loop, high temperature test of a BJ Liner-Motor Nuclear Pump can be performed to meet any customer or governmental specifications.



PRECISE ALIGNMENT, here being performed on a special granite slab, is typical of both the special facilities available, and the care and skill of workmanship built into each BJ Pump.

BJ

Here's BJ's program for delivering a quality pump ...on time!



Quality takes time. Time for careful construction techniques, and time for the extra steps necessary to check, test, inspect and examine a quality product.

Byron Jackson works two ways to assure delivery of a quality pump as scheduled.

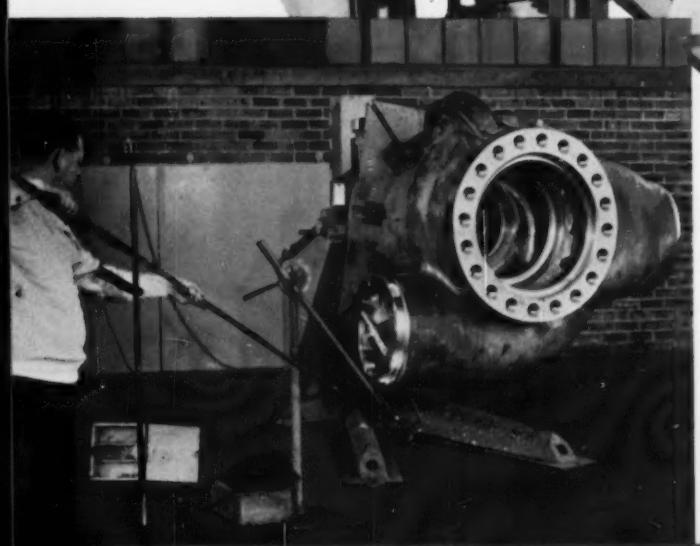
First, on standard type BJ Pumps, adequate inventories of all initial and spare parts are kept at strategic locations throughout the country. Complete pumps or parts can be delivered almost off-the-shelf!

For custom engineered BJ Pumps, an extra large and efficient engineering department is at your command to produce a pump to your specifications —yet with the background of BJ's experience in quality manufacturing since 1872.

After engineering approval, BJ's complete and advanced facilities, some of which are shown here, go to work to build your pump, and to prove its worth through the numerous tests.

Metallurgical control of materials, improvements in processing techniques and non-destructive testing assure a pump built to meet your most exacting specifications.

"CLEAN ROOM" facilities provide cleaning and final assembly of pumps in a completely dust-free atmosphere. It is used primarily for pumps going into nuclear or cryogenic service.



RADIOGRAPHIC INSPECTION of castings, shown here, as well as helium leak testing, dye penetration, ultrasonic and Magnaflux inspections are the type of control procedures used to build the quality in BJ Pumps.

Proved

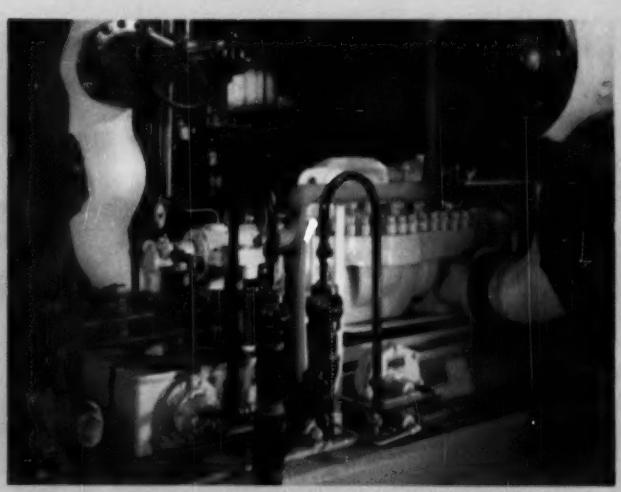
Proved reliable in every application!

The result of BJ's experience in building thousands of pumps for every type of service, is a remarkable record of "World's First's."

From the first deepwell turbine pump in 1901, to the current World's largest boiler feed and liquid sodium nuclear pumps, BJ has maintained leadership in pump building.

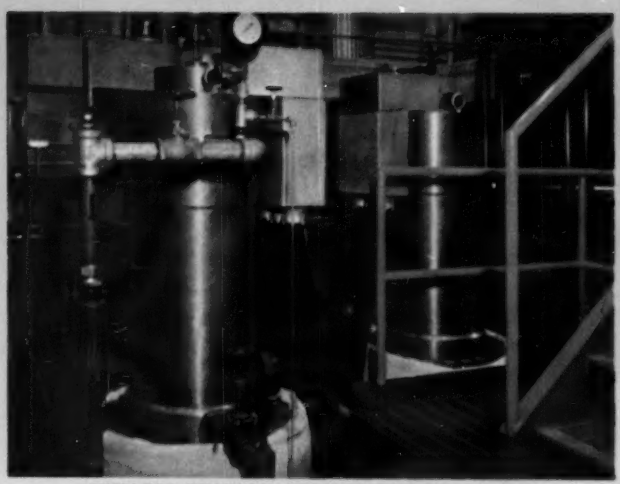
Name your application—BJ can match it with a reliable pump, proved in service, and backed by experience!

VERTICAL CIRCULATING AND DEEPWELL PUMPS



BOILER FEED, PIPELINE AND HIGH PRESSURE PUMPING

REFINERY, CHEMICAL AND PROCESS PUMPS



NUCLEAR REACTOR, PRIMARY COOLANT PUMPS

Byron Jackson Pumps, Inc.

SUBSIDIARY OF BORG-WARNER CORP.

BJ

P.O. Box 2017A Terminal Annex
Los Angeles 54, California

The New N&W . . .

NATION'S GOING-EST RAILROAD!

- America's newest fleet of diesel locomotives . . . 529 units with average age only 2.5 years.
- 81,006 modern freight cars — more per mile of line than any other major U. S. railroad.
- Busiest large railroad . . . greatest freight traffic density.
- A 30% longer railroad with merger of the Virginian into Norfolk and Western. *Wonderful new industrial sites.*
- New, easier grades, more interchange points with other railroads.
- Now a billion dollars in assets.

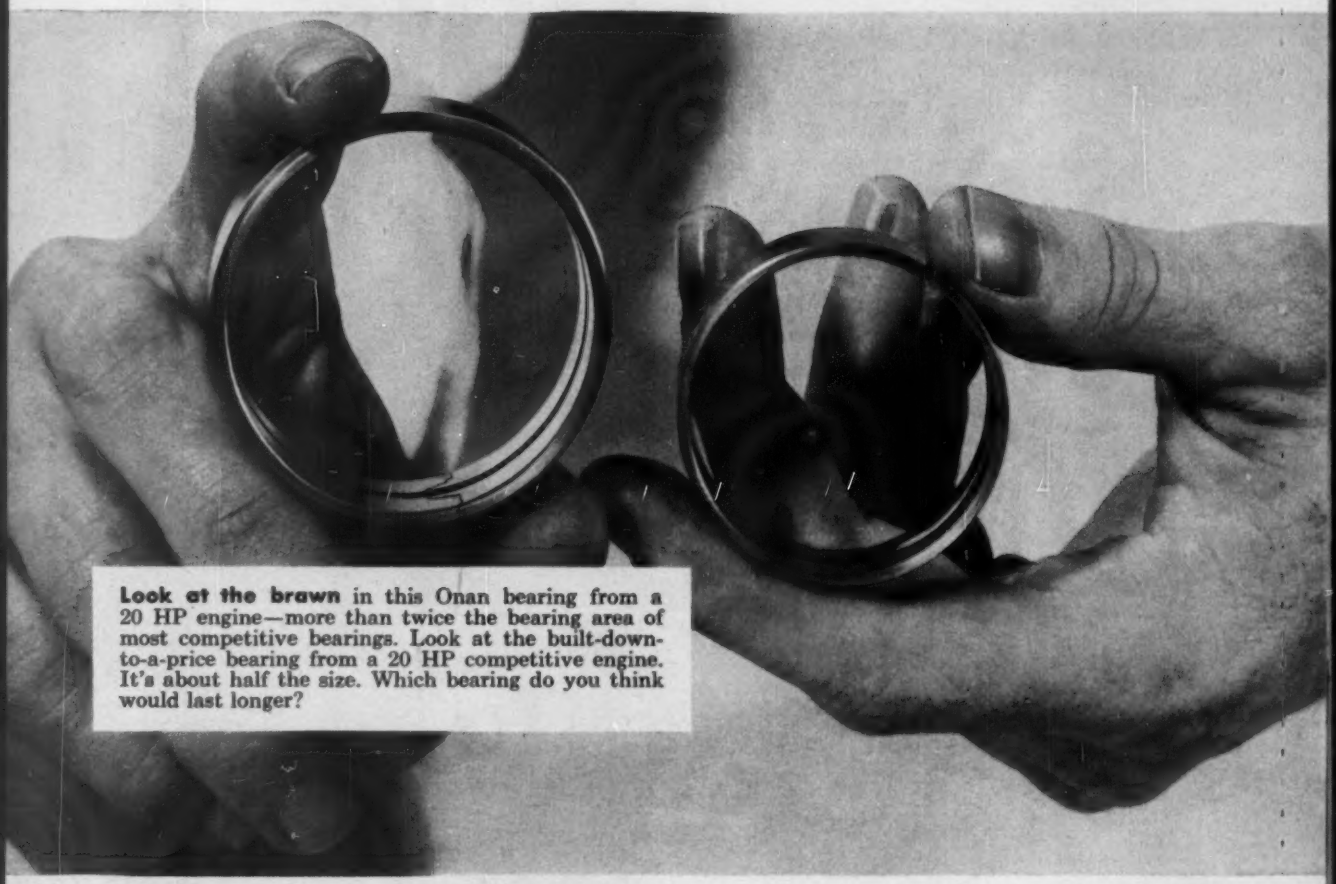
This is why the dynamic, new Norfolk and Western means savings in time and money to shippers!

Norfolk and Western Railway

GENERAL OFFICES • ROANOKE, VIRGINIA

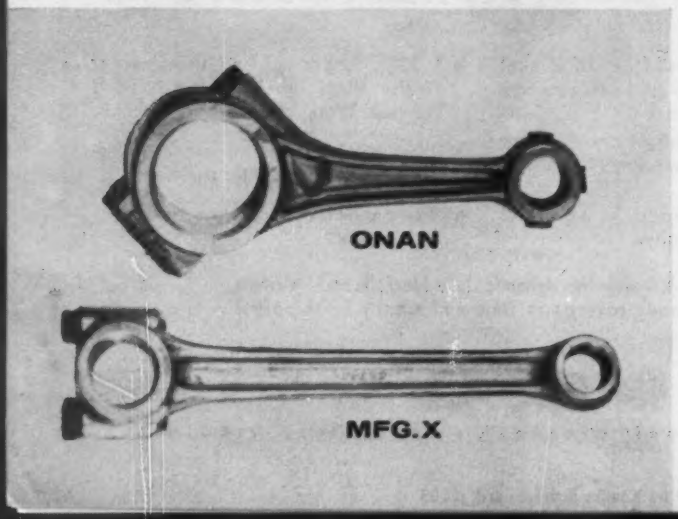
For more facts circle 223 on Reader Service card, p 103

Big, beefy bearings make than ordinary

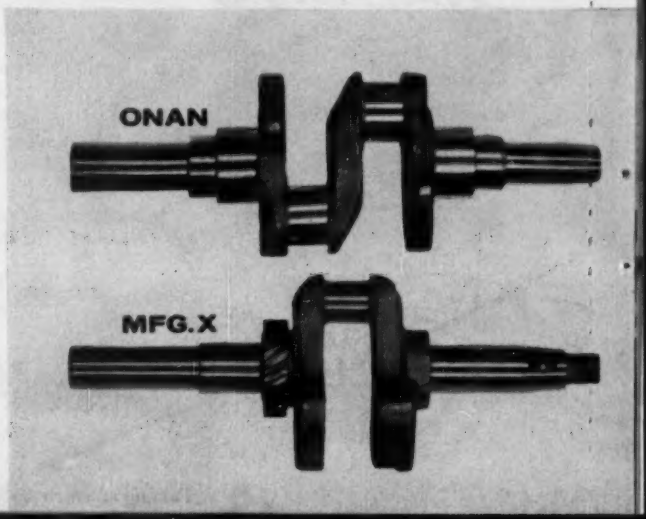


Look at the brawn in this Onan bearing from a 20 HP engine—more than twice the bearing area of most competitive bearings. Look at the built-down-to-a-price bearing from a 20 HP competitive engine. It's about half the size. Which bearing do you think would last longer?

Connecting rods—The shorter stroke of the Onan engine permits the use of a shorter rod, a more rugged design that stands up longer under heavy duty service—another example how Onan builds *up* to performance, not down to a price.



Crankshafts—Larger diameters of main and rod journals make Onan crankshafts stiffer and stronger, minimizing the possibility of breakage or bending. More "muscle" throughout Onan engines means longer life, extra years of full-rated performance.



Onan last years longer electric plants

Onan bearings are about twice the size of most competitive bearings

Bearings take a beating in any engine. But, with Onan's bigger bearings the strain is spread over a wider area, giving you longer, more economical engine life.

This is just one example of the extra quality you find in Onan Electric Plants. Each one is checked out at full load for hours before it goes to the shipping dock. Engineers have designed 134 separate tests to make sure it operates the way it is supposed to. Not only that, inspectors from independent laboratories pay surprise visits to the Onan factory, pull units off the line and put them through their paces. It's a double check—on Onan tests and testing methods.

There's an Onan representative near you, ready to tell you about the complete line of Onan Plants, from 500 watts to 230,000 watts. Look for his name in the telephone classified section in all major cities, or write direct.

ONLY ONAN GIVES YOU THIS GUARANTEE

PERFORMANCE CERTIFIED
We guarantee that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.
D. W. ONAN & SONS INC.
Minneapolis 14, Minnesota
Onan

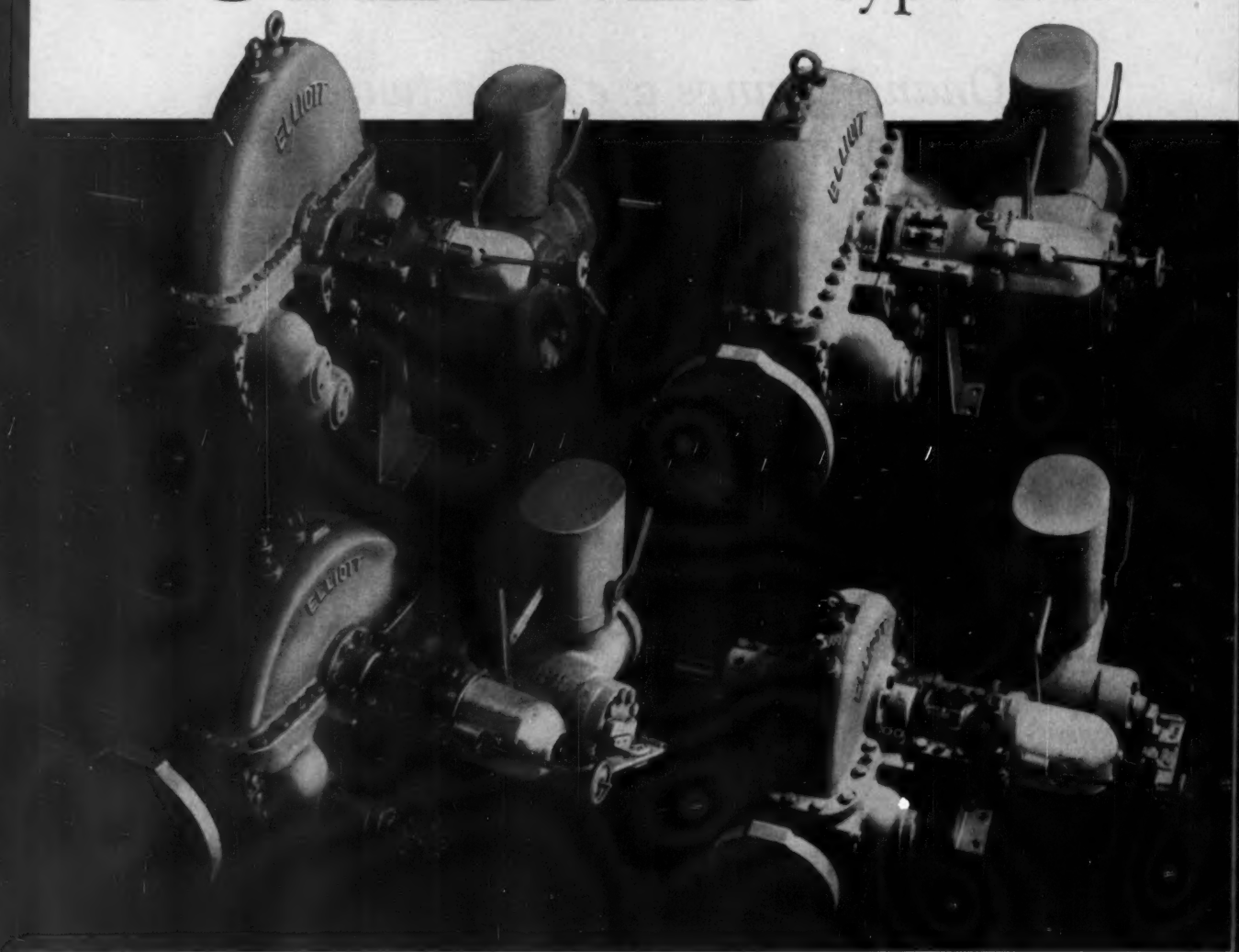
Onan®

World's Leading Builder of Electric Power Plants

D. W. ONAN & SONS INC., 2564 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

For more facts circle 224 on Reader Service card, p 103

ELLIOTT mechanical drive TURBINES type YR



STURDY! WEATHERPROOF! DEPENDABLE!

All-weather protection, standard for Elliott type YR turbines, assures dependable operation under all conditions of heat, cold, moisture, dust and contaminated atmosphere.

The direct-acting speed-governing system is simple and positive, available in several modifications to match speed and pressure requirements. The rugged rotor assembly is dynamically balanced. Bearings and shaft seals are readily accessible for maintenance. Hand valve reduces steam consumption at partial loads.

Many other features contribute to the dependable and economical performance of Elliott type YR turbines. Write for complete details to Turbine Division, Elliott Company, Jeannette, Penna.

ELLIOTT Company
Jeannette, Pennsylvania

HO-1

For more facts circle 225 on Reader Service card, p 103

New FLAKED Super Filmeen obsoletes all other filming amines

Totally effective, easiest to handle and use, most economical—this is the verdict of power engineers on the latest development from Dearborn's research laboratories—Super Filmeen in FLAKE form.

This free flowing, finely divided waxy flake is easily handled and weighed; readily dispersible...31% more active than ordinary octadecylamine acetate...not subject to dehydration at super-heated steam temperatures...will not hydrolyze to acetic acid... remains alkaline in feed solutions.

Shipped as 100% active ingredients—saves on freight.

Update YOUR condensate return line protection with Super Filmeen. Call your Dearborn Engineer or send for detailed Technical Bulletin today!

DEARBORN CHEMICAL COMPANY

Executive Offices: Merchandise Mart, Chicago 54
Plants and Laboratories: Chicago • Linden, N. J. • Los Angeles
Toronto • Honolulu • Havana • Buenos Aires

pioneer in the science of corrosion control

For more facts circle 226 on Reader Service card, p 103

I-T-E's advanced fused interrupter switchgear with a Single Assembly Rating

Slash Power Switching Costs with Assurance of Safe Fault Closing and Long Interrupting Life. No longer do you need worry about individual component ratings for fused interrupter switchgear. With I-T-E's advanced Power Switching Centers you only concern yourself with specifying system conditions. I-T-E then *matches* a single assembly to your system requirements. You are assured of an integrated unit . . . switch, operating mechanism, fuse and housing . . . that will safely withstand the effects of *closing*, *carrying* and *interrupting* all values of current up to your system's specified short circuit capability (up to 600 amperes, continuous—and 500 mva short circuit capability).

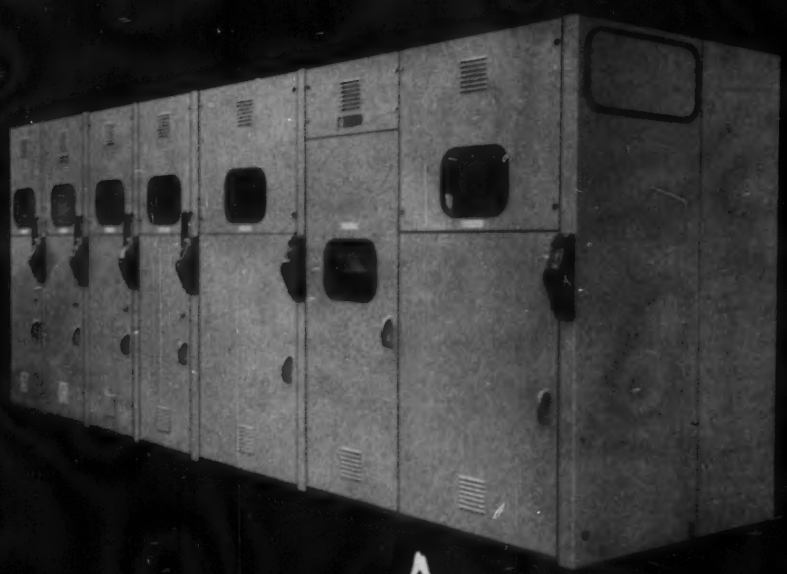
Realize maximum economy where all the features of circuit breakers are not required. Prevent misapplication of protective equipment with I-T-E's Single Assembly Ratings. Get the complete story from your nearest I-T-E sales office or write I-T-E Circuit Breaker Company, Greensburg, Pa.

I-T-E matches a combination of components to your total system requirements

I-T-E CIRCUIT BREAKER COMPANY
GREENSBURG, PENNSYLVANIA

For more facts circle 227 on Reader Service card, p 103

Housing must withstand the effects of short circuits



The LOWEST RATED Component Determines Total Fault Protection!

Switch must pass continuous load current and momentarily withstand fault current

Under fault conditions, the mechanism must positively close the switch and/or hold it closed against short circuit current

Fuse must pass continuous load current and interrupt fault current

Super 70's "On Stream"

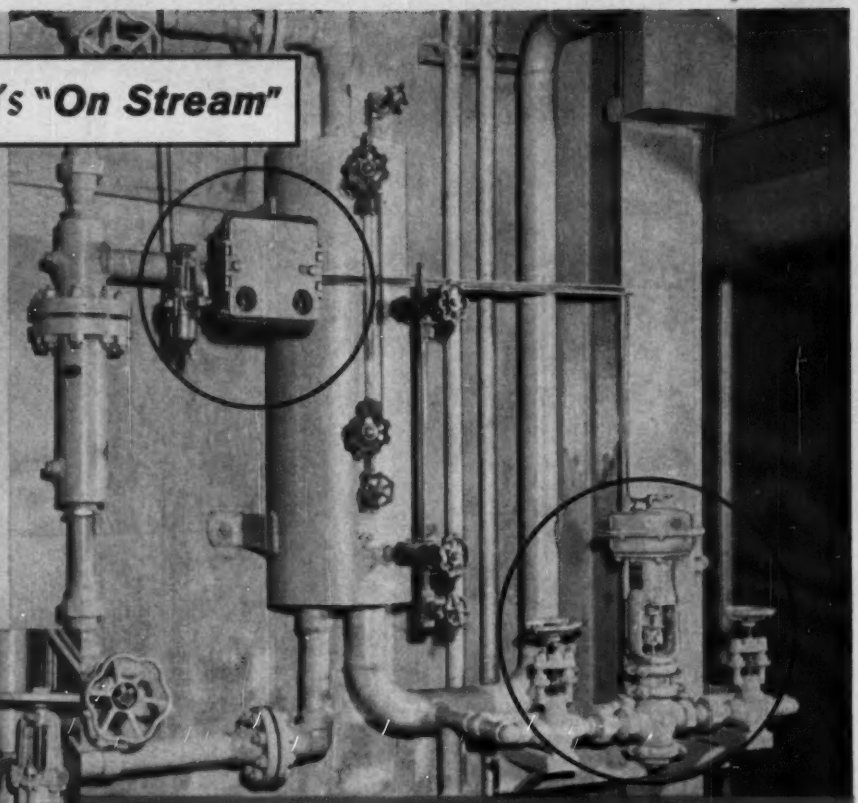


Photo at right shows a turbine gland exhauster level control system with BS&B Level Control and Super 70 Control Valve.

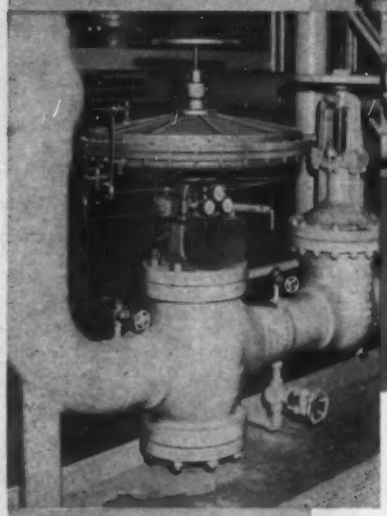


Photo above shows a BS&B pressure-balanced deaerator level control valve, complete with valve positioner, reverse acting relay and booster relays.

BS&B CONTROLS . . . "On The Job" At Conesville!

Conesville No. 2, one of two new 125,000 KW steam-electric generating units for Columbus and Southern Ohio Electric Company, is now "on the line" at Conesville, Ohio.

BS&B Controls make up an important part of the controls system of this plant, with Super 70 Control Valves installed in Heater Drain, Steam Reducing and Water Supply Services. BS&B Level, Pressure and Temperature Controllers also play an important role in this plant's automatic operation.

Conesville No. 1, a "sister" unit now under construction for C and SOE, is similarly equipped with BS&B Controls and will go into service sometime early this year. BS&B personnel worked closely with the staffs of C and SOE, and Ebasco Services Incorporated, Engineers and Constructors, in the design, application and operation of these control systems.

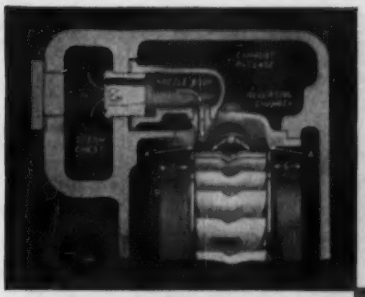
Next time you have a new station "on the boards," specify BS&B Controls right down the line. They're dependable, efficient, and cut down maintenance costs. You'll get application engineering assistance, too!

SUPER BS&B 70

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-Q5

7500 East 12th Street - Kansas City 26, Missouri



TWO REASONS WHY

this turbine seldom sees down time

1 ***Generous wheel clearances:*** AA —rim clearance, B—blade clearance, CC —side clearance. Blades can't foul as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large (about one inch) that end-play from excessive external thrust cannot damage wheel.

2 ***Blade wear is of little consequence.*** In a Terry solid-wheel turbine, the steam enters the buckets at right angles to the shaft. As its power-producing action takes place on the curved surfaces at the backs of the buckets, wear does not materially affect horsepower or efficiency.

To prevent costly shutdowns for repairs, Terry builds bonus reliability into each solid-wheel turbine. Two of the ways in which this is accomplished are shown in the diagrams at the left.

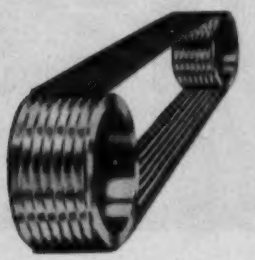
Further details of these simple, fool-proof turbines are illustrated and described in bulletin S-116. If you do not already have a copy of this publication, send for one today. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1217

TERRY

For more facts circle 229 on Reader Service card, p 103



- *NO MATCHING PROBLEMS*
- MAINTAINS GROOVE SHAPE
- COMPLETE CONTACT-PRESSURE
- CONSTANT PITCH AND SPEED RATIOS
- LESS MAINTENANCE—LESS TAKE-UPS
- LESS BELT AND SHEAVE WEAR

Write for Bulletin M141

R/M POLY-V® DRIVE

MORE POWER...*in Less Space*
WITH MORE RELIABILITY

Designed for high volume forgings, this giant 2500 ton automated press developed by Erie Foundry Company is powered by a 250 HP Poly-V Drive. This new drive provides much higher horsepower capacity . . . delivers more dependable power per inch of drive width than ever before possible! Poly-V features a single unit V-ribbed belt across full width of the drive sheave—not an assembly of V-belts. Single unit belt design eliminates length matching problems — minimizes equipment down-time and belt replacement costs, runs cooler, smoother.

Just two cross sections of Poly-V Belt meet every heavy duty power transmission requirement. Ask your R/M Distributor for details about R/M Poly-V* Drive.

*Patented

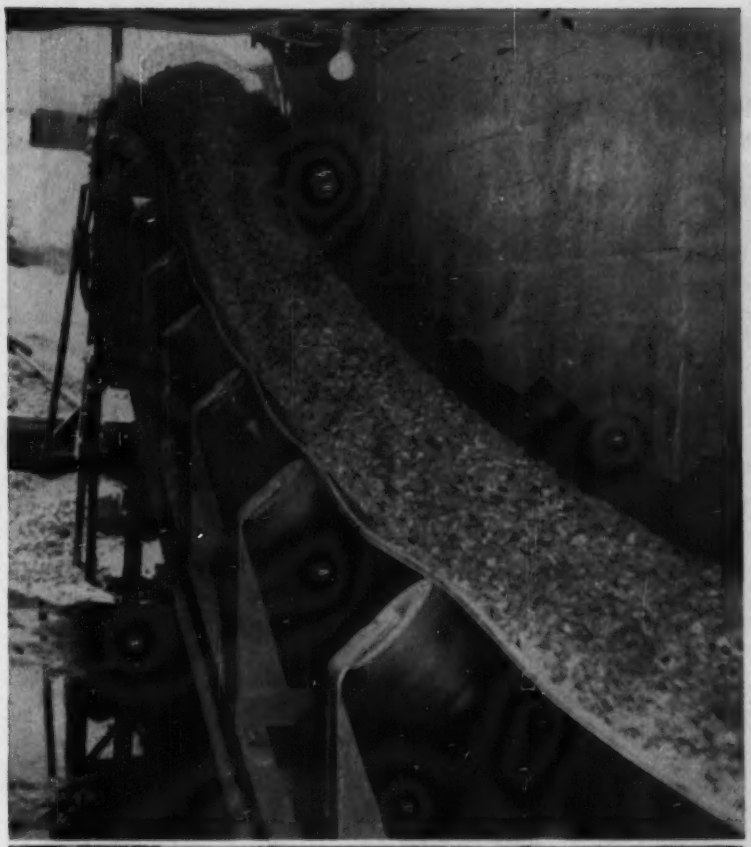
WHEN YOU CHANGE DRIVES . . .
CONVERT TO POLY-V AND BE SURE!

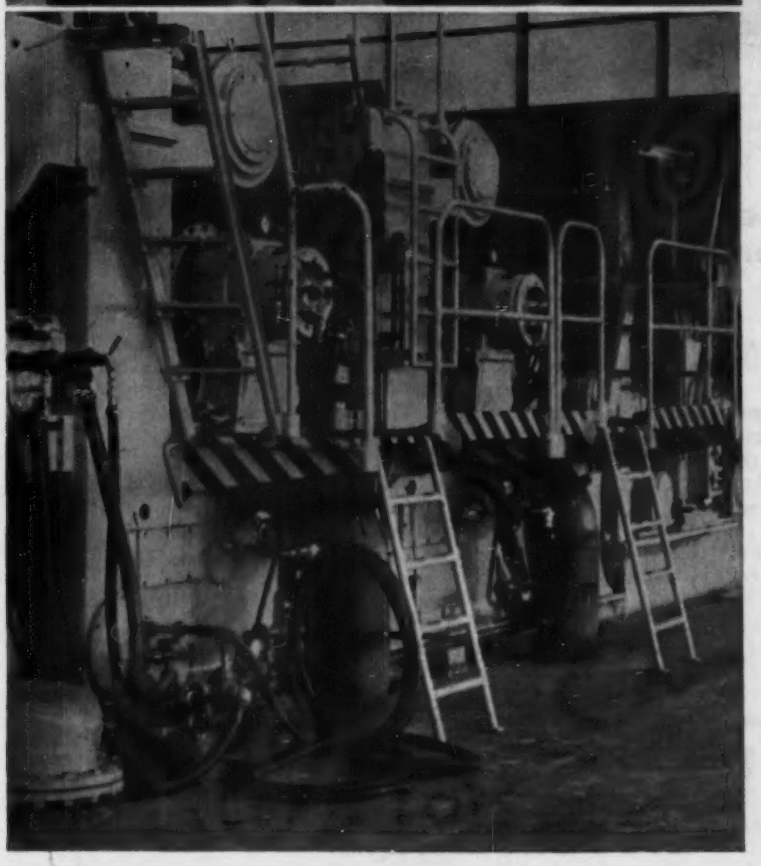
RM1030

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

RM

ENGINEERED RUBBER PRODUCTS . . . "MORE USE PER DOLLAR"





RAY-MAN CONVEYOR BELT

Engineered for 45° Idlers

- TRAINS NATURALLY
- TROUGHS DEEPLY
- HOLDS FASTENERS
- RESISTS IMPACT AND RIPPING
- REQUIRES NO BREAKER PLY
- DOUBLE COMPENSATION RELIEVES OUTER PLY STRESS
- EXCLUSIVE "XDC" LONG-WEAR COVER

Every component of a Ray-Man Conveyor Belt is *precision proportioned* to give you a balanced belt construction, with as much as ½ longer life expectancy. It's the same as getting ½ more conveyor belt for your money. Further savings are possible, if you use 45° Idlers. Properly engineered, you can haul a fuller load, or install a narrower conveyor. Ray-Man is guaranteed against ply or cover separation at the hinge line where the 45° angle proves too sharp for regular belt constructions. Write for Bulletin M303.

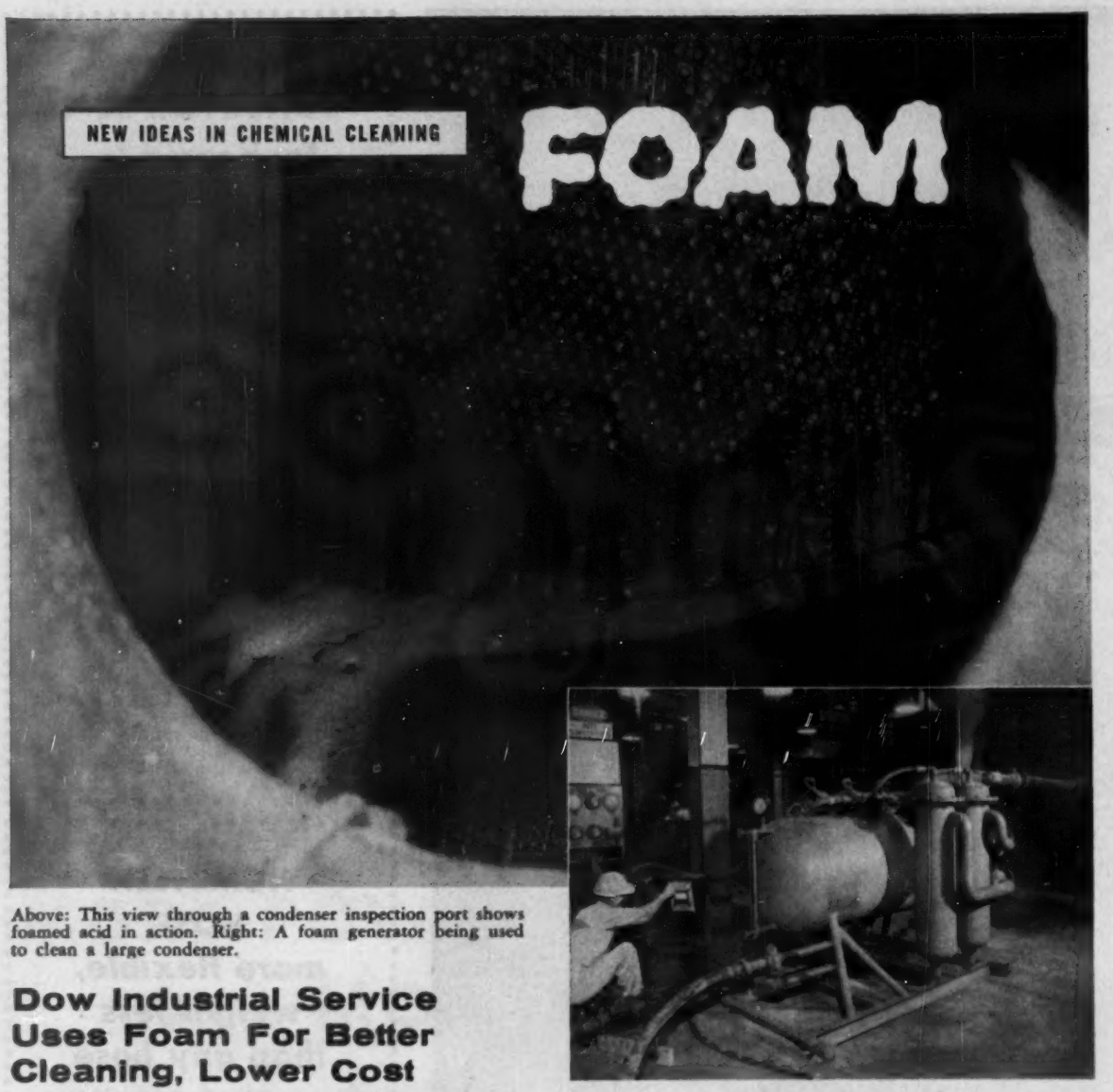
HOMOFLEX HOSE

more flexible, weighs less than any hose for equal pressure

- SUPER-STRONG
- PRECISION BUILT
- NO PRE-SET TWIST—WILL NOT KINK
- INSEPARABLE TUBE-TO-COVER BOND
- UNIFORM INSIDE AND OUTSIDE DIAMETERS
- EASIER, SAFER COUPLING

Strong, lightweight, and "flexible as a rope"—Homoflex is the easiest handling hose and lasts longer. Made in types for air, water, other fluids and gases. Ask about other types of R/M rubber hose for your job applications. Write for Bulletins M620 and M694.

For more facts circle 230 on Reader Service card, p 103



Above: This view through a condenser inspection port shows foamed acid in action. Right: A foam generator being used to clean a large condenser.

Dow Industrial Service Uses Foam For Better Cleaning, Lower Cost

A newly-developed method of chemical cleaning is helping plant operators reduce the cost of cleaning large-volume vessels.

The new method uses a foaming agent and a special foam generator to expand inhibited acids, water or alkaline solutions to many times their liquid volumes. Foam-to-liquid ratios up to 300-to-one can be attained. For most applications, however, acid is expanded 20 times.

Chemical costs of cleaning large volume vessels with foam instead of liquid are reduced because far less solvent is required.

Reduced solvent requirements mean that disposal or neutralization is simplified.

The light weight of foam makes possible the chemical cleaning of structures where weight is critical.

Foam cleans faster than liquids because solvents can be used at higher concentrations. This helps to reduce both cleaning and outage time.

Certain mechanical benefits result from the use of foamed solvents. The foam provides a scouring action not given by liquids and it carries sloughed materials readily.

Also, foamed solvent fills vessels, pipes and even bent piping as a plug. This eliminates the need for vent connections and reduces the hazard of gases because they are swept out as they are formed.

The foam cleaning technique is just one of many recent developments by Dow Industrial Service to make chemical cleaning faster, safer and less costly.

For engineered recommendations to solve your cleaning problems, contact the field office nearest you, or write Dow Industrial Service, 20575 Center Ridge Road, Cleveland 16, Ohio.

Chemical Cleaning Services for all industry

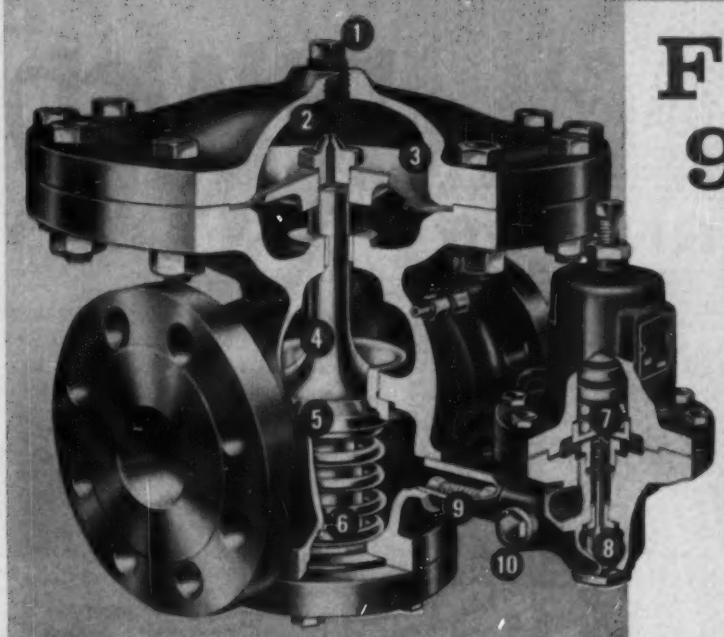
DOW INDUSTRIAL SERVICE

DIVISION OF THE DOW CHEMICAL COMPANY

DOW

For more facts circle 231 on Reader Service card, p 103

No Clogged Orifices — No Sticky Valves
No Diaphragm Rupture Install the Improved



FISHER 92B STEAM REDUCING VALVE

1. Pipe plug directly over bleed orifice for cleaning ease
2. Bleed orifice designed to reduce plugging
3. Stainless steel diaphragms for maximum strength
4. One-piece stainless steel inner valve and stem
5. Stainless steel seat ground at 60° angle
6. Inconel valve spring resists corrosion
7. Bellows seat eliminates pilot valve sticking
8. Pilot valve seat of hardened stainless steel
9. Removable strainer to protect pilot valve seat
10. Pipe plug for easy strainer flushing

Now Available in Tough High Strength Nodular Iron For Pressures Up To 300 psi

Here's a pilot operated, pressure reducing valve designed to minimize problems inherent in steam service. Fisher 92B is a completely self-contained unit. It is especially desirable for use where air or gas is not available as an operating medium.

Once installed the 92B is easily maintained. The bleed orifice can be cleaned by removing one fitting.

PRESSURE RATINGS AND SIZES

Body Material	Working Pressures	End Connections	Body Sizes
IRON	250 psi @ 410°F	Screwed	½"–2"
	125 psi @ 388°F	125 lb. flgd.	1½"–6"
	250 psi @ 410°F	250 lb. flgd.	1½"–6"
NODULAR IRON	300 psi @ 450°F	Screwed	½"–2"
	150 psi @ 388°F	150 lb. flgd.	1½"–3"
	300 psi @ 450°F	300 lb. flgd.	1½"–3"

The inner valve, seat ring and main spring can all be reached through the blind flange. The 92B reduces inlet pressures up to 300 psi down to outlet pressures from 2 to 150 psi. Precision construction of the pilot gives the valve exceptionally close accuracy.

NODULAR IRON CONSTRUCTION

The 92B is now available in Type 60-45-15 Nodular (ductile) iron (ASTM No. A395-56T). This extremely tough, high strength iron can be cast into the intricate shapes of the 92B and still retain full strength and pressure tightness. In addition Nodular iron resists corrosion, extreme heat and thermal shock. Precision machining plus rugged Nodular iron construction adds up to this notably improved version of the time-tested 92B.

WRITE TODAY FOR FULL DETAILS
ASK FOR BULLETIN D-92B

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

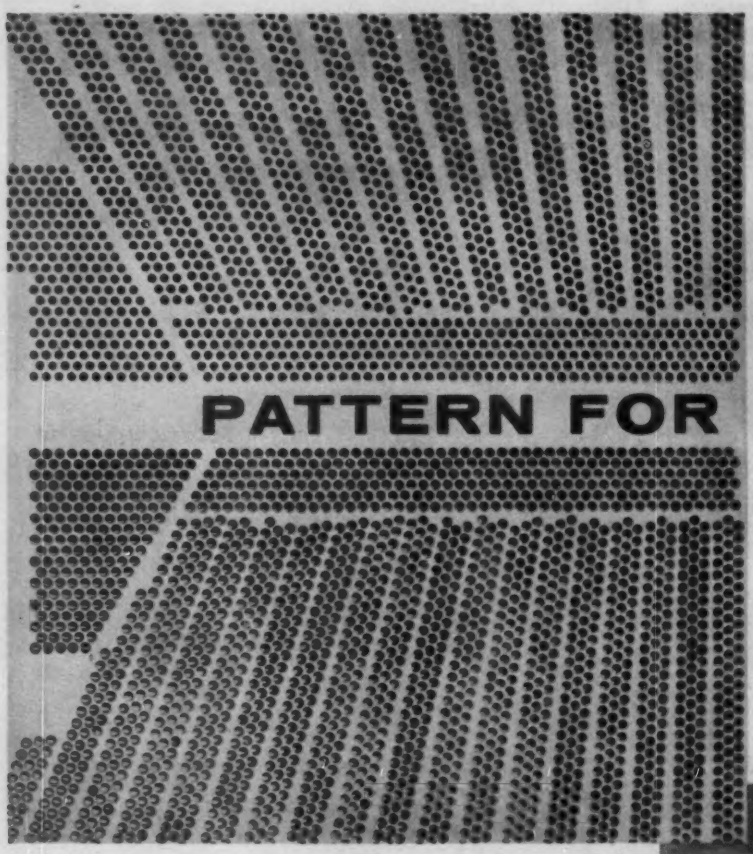
Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

FISHER

SINCE 1880

For more facts circle 232 on Reader Service card, p 103



PATTERN FOR POWER

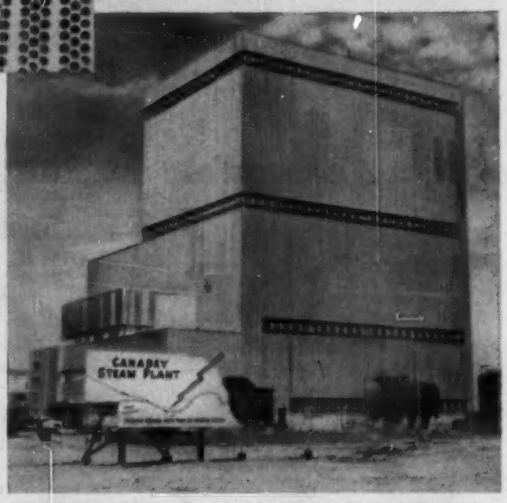
Revere Muntz Metal Plates are combined with Revere Copper Condenser Tubes to produce reliable power for new Canaday Steam Plant, Lexington, Neb.

This new 100,000 kw. plant owned and operated by The Central Nebraska Public Power & Irrigation District, Hastings, Neb., depends on a Foster Wheeler condenser for its source of power.

Revere Arsenical Copper Condenser Tubes and Revere Muntz Metal Plates were selected by Foster Wheeler to fit the specific operating conditions that will be encountered in this particular operation. Other operating conditions require other alloys.

It is this careful selection of the "metals to fit the job" that has built, for Revere, a reputation for dependable condenser tube and plate performance under all kinds of operating conditions.

Over the years, Revere's Research Department has compiled extensive data regarding the relative corrosion resistance of the different alloys under a wide variety of operating conditions. Why not take advantage of this storehouse of facts and consult with Revere's Technical Advisory Service before selecting the tubes and plates for your equipment?



ABOVE YOU SEE exterior of the Canaday Steam Plant which is equipped with a Foster Wheeler condenser. The 4 Revere Muntz Metal Plates used measure 7' 10" x 10' 3" x 1¼" while the Revere Arsenical Copper Tubes are 1" O.D. x 18BWG x 30'.

REVERE COPPER AND BRASS INCORPORATED

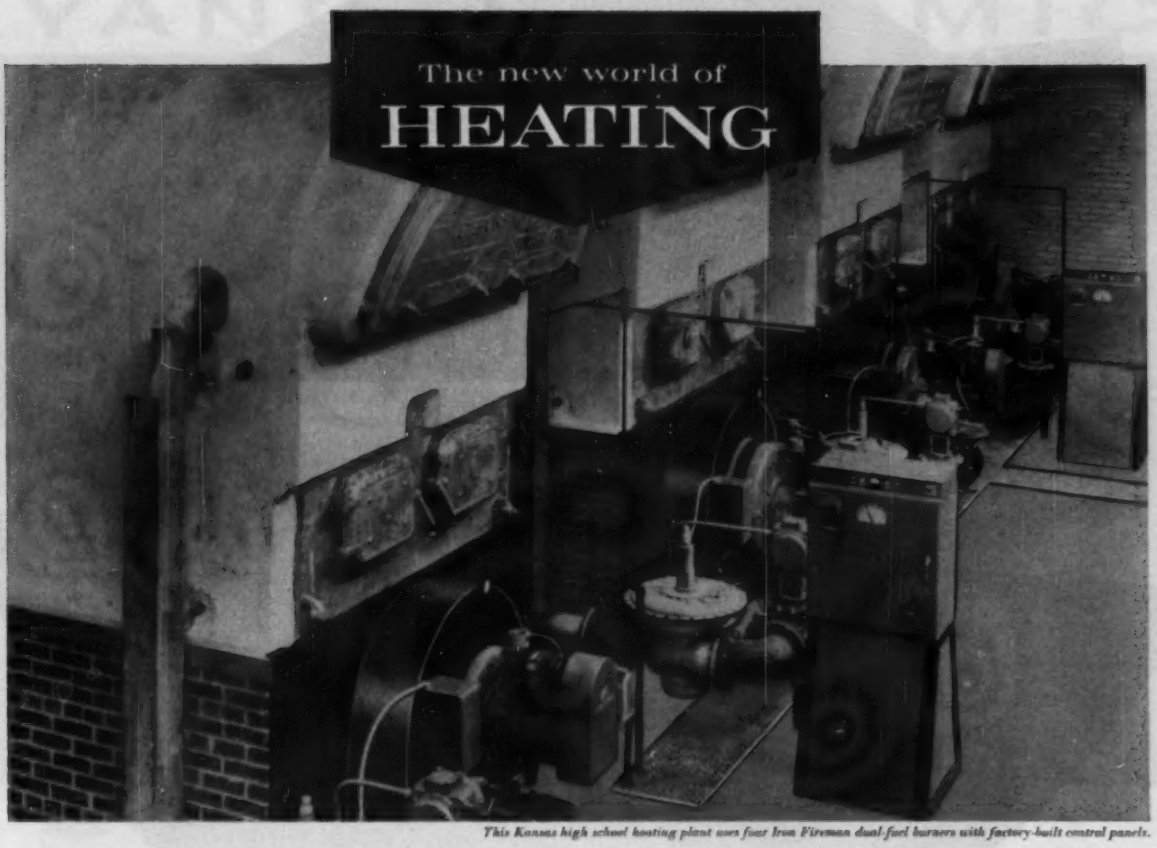
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N.Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

COPPER • BRASS • REVERE • ALUMINUM

INTEGRAL FINNED TUBE • BOILER TUBE • INSTRUMENT TUBE • CONDENSER TUBES IN CUPRO-NICKEL, ALUMINUM BRASS, ADMIRALTY, HERCULOY, ARSENICAL COPPER, MUNTZ METAL AND OTHER ALLOYS. ALUMINUM TUBE, SHEET AND EXTRUSIONS. SMALL AND LARGE PLATES IN CUPRO-NICKEL, COPPER, HERCULOY, MUNTZ METAL, NAVAL BRASS AND ADMIRALTY.

For more facts circle 233 on Reader Service card, p 103



This Kansas high school heating plant uses four Iron Fireman dual-fuel burners with factory-built control panels.

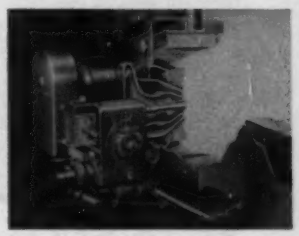
Add high efficiency firing *without boiler alteration*

Factory engineering replaces local "cut and try" firebox design

The Iron Fireman AirRing* dual-fuel burner (shown in the high school heating plant above) is a complete factory built package that is simply bolted to the boiler front.

The package includes both primary and secondary air systems, combustion safety controls, ignition and fuel systems for either one or two fuels, and factory engineered refractory combustion throat.

This compact unit not only reduces on-the-site construction, but achieves superior performance by supplementing local craftsmanship with experienced application engineering. Complete combustion is accomplished without flooding the firebox with excess air.



This cutaway shows how oil, gas and air are introduced into the combustion chamber through a single firing port. No checkered floor, firing arch or boiler pit. Flame is generated within a cone of air—no inefficient infusion of underfloor air.

*Trade-Mark

Mail coupon for full information and specifications.

IRON FIREMAN

HEATING AND AIR CONDITIONING
AIRCRAFT COMPONENTS AND EQUIPMENT
MISSILE AND AIRPLANE GYROSCOPES
ELECTRONIC EQUIPMENT
CONTROL INSTRUMENTS

Iron Fireman Mfg. Co., 3055 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward St., Toronto)

Please send complete technical description and specifications on Iron Fireman AirRing firing.

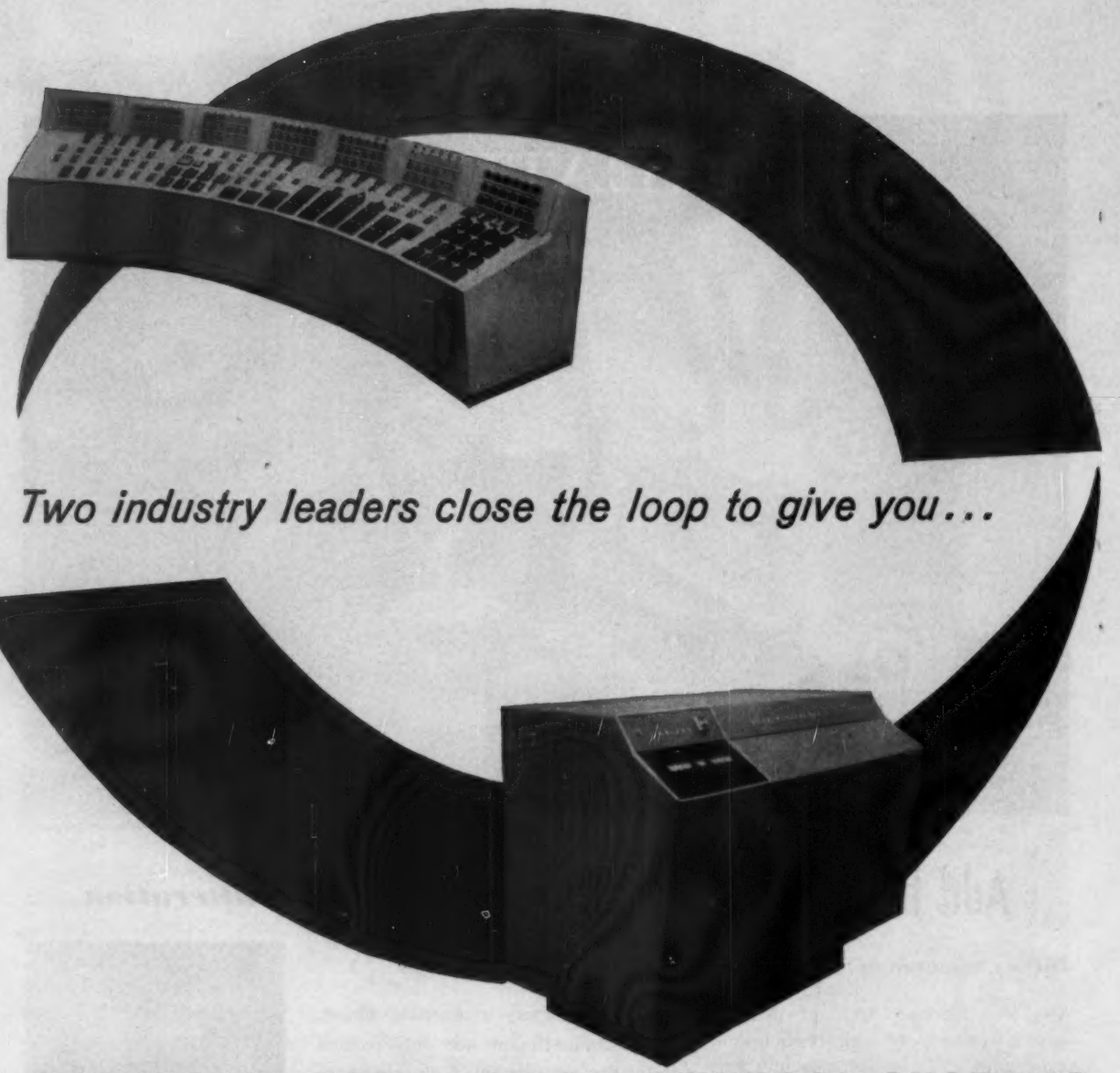
Name_____

Firm_____

Address_____

City_____ State or Prov._____

For more facts circle 234 on Reader Service card, p 103



Two industry leaders close the loop to give you...

COMPUTER COMBUSTION CONTROL SYSTEMS

REPUBLIC FLOW METERS CO., the leader in electronic combustion control, and the THOMPSON-RAMO-WOOLDRIDGE PRODUCTS COMPANY, the leader in computer process control and manufacturer of the outstanding RW-300 Digital Control Computer, have "closed the loop." Through a co-operative plan, they have created a unique pool of engineering experience to give you these important advantages when planning automated power plants:

—coordinated sales service
—coordinated engineering service
—coordinated installation and operation service

Republic Flow Meters Co. (a subsidiary of Rockwell Manufacturing Company) has been a leader in pneumatic combustion control systems for over a quarter of a century, and during the last 10 years has designed over 125 electronic combustion control systems for steam generating plants. Republic engineering experience and product reliability in combustion control, feedwater control, superheat and reheat control, is assurance of system reliability.

Thompson-Ramo-Wooldridge Products Company (a division of Thompson Ramo Wooldridge, Inc.) has been the leader in developing industrial computer control systems for over five years. The RW-300 Digital Control Computer, designed specifically for closed loop control and on-line data reduction, has demonstrated around-the-clock reliability in 14 industrial installations.

These two leading companies now offer coordinated engineering, installation and service for completely integrated control systems. Sales engineers located in principal cities throughout the nation can provide details of this cooperative plan, or either company may be contacted directly—Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Illinois—The Thompson-Ramo-Wooldridge Products Company, 202 North Canon Drive, Beverly Hills, California.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

For more facts circle 235 on Reader Service card, p 103
circle 236 on Reader Service card, p 103 ➤

YANKEE ATOMIC

trouble-free performance

installing more
than 70 miles of

SCOVILL®

INHIBITED ADMIRALTY

heat exchanger

TUBE

HIGH RELIABILITY . . . trouble-free performance . . . has become a very specific goal of engineers in the Atomic Age.

This applies whether the problem is reliability of controls in a space vehicle or reliability of the operating equipment in New England's first Atomic Power Plant at Rowe, Massachusetts, being designed by Stone & Webster Engineering Corporation in collaboration with Westinghouse and constructed by Stone & Webster.

Scovill salutes the Yankee Atomic Electric Company's project, where 11 future-minded New England Utilities have set a new milestone in a field of unlimited promise.

Scovill's contribution is HEAT EXCHANGER TUBING . . . mile upon mile of precision-built tube that shoulders a major responsibility for the trouble-free operation of this installation.

Here are shown being installed some of the more than 12,000, 30-ft. long Scovill Inhibited Admiralty Tubes (⅞" OD X .049" wall) specially made to extremely tight specifications for the main condenser in the Yankee Atomic Electric Company plant . . . over 70 miles of tube, every foot of which has passed the most rigid inspection.

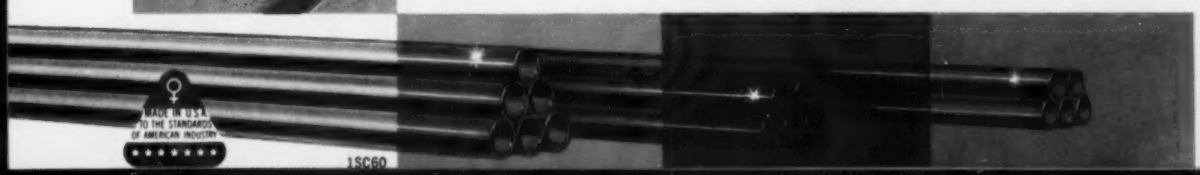
Here, as elsewhere, Scovill Heat Exchanger Tube alloys and Scovill Technical Services have been recognized as among the finest available . . . to assure trouble-free performance.

HEAT EXCHANGER TUBE for Applications from Marine to Petrochemical, from Compressor Intercoolers to "Cat-Cracker" Exchangers, in these popular Alloys . . . Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Red Brass, 85% • Deoxidized Copper • Arsenical Copper • Cupro-Nickel, 10%-20%-30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

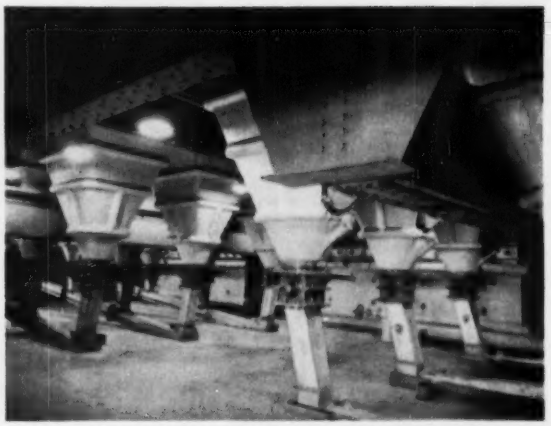
SCOVILL

SCOVILL MANUFACTURING COMPANY

Mill Products Division, 99 Mill Street, Waterbury, Connecticut. Phone PLaza 4-1171.



How Commonwealth Edison Turned a Fly Ash Problem Into Profit



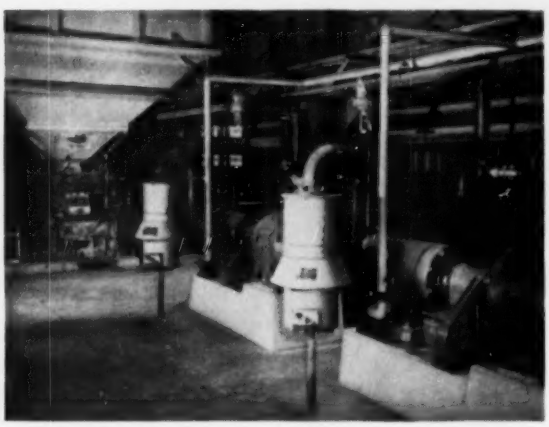
F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.

At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

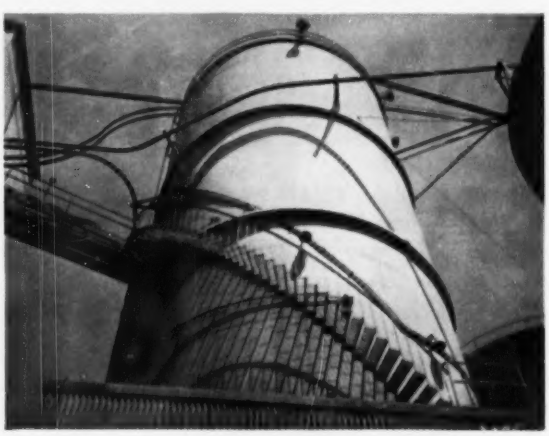
Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash.

Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

1335A
G-203 A

Fuller
pioneers in harnessing AIR

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Offices in Principal Cities.

FULLER COMPANY GENERAL AMERICAN TRADE MARK

For more facts circle 237 on Reader Service card, p 103

FLUOR COOLING TOWERS

higher thermal performance

lower maintenance cost

built-in permanence

etc.*

* The et ceteras make profitable reading. Would you like a free copy of our catalog FP-118 that describes in detail the designed quality of Fluor towers?

CTI

Fluor PRODUCTS COMPANY

INDUSTRIAL COOLING TOWERS

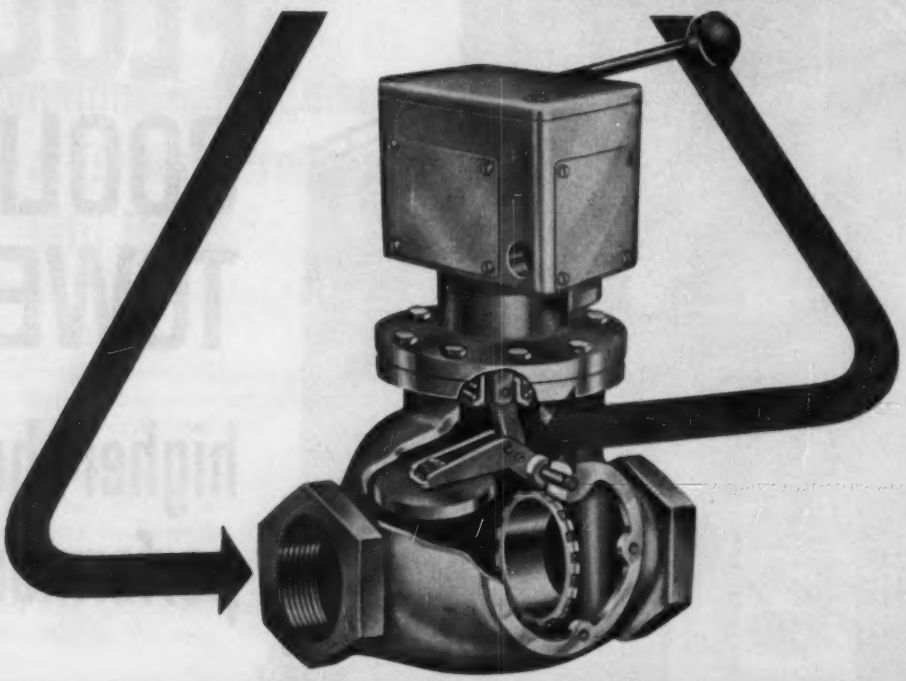
A division of The FLUOR CORPORATION, Ltd.

GENERAL OFFICES:
SANTA ROSA, CALIFORNIA

For more facts circle 238 on Reader Service card, p 103

Which of these major gas valve problems is yours?

CAPACITY? SAFETY?



THIS NEW GENERAL CONTROLS HI-FLO GAS VALVE SOLVES BOTH... AND MORE

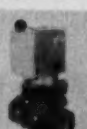
Straight through flow provides maximum capacity — minimum pressure drop. Vertical seating prevents build-up of foreign matter on valve seat, and soft seat insures positive shutoff. Short 90° travel reset handle for easy opening *and* closing, manually. H-117 model incorporates dual release actuator, and fixed or adjustable opening speeds. Before you buy *any* high capacity gas valve, check this capacity table. You'll find your nearest General Controls factory representative in the yellow pages.

GENERAL CONTROLS

COMPARE THESE GAS CAPACITIES

GAS CAPACITY — 1" DROP

PIPE SIZE (INCHES)	HI-FLO VALVE			CONVENTIONAL GLOBE VALVE
	CU. FT. HR.	MAX OPER. PRESS. P.S.I.	Cv FACTOR	CU. FT. HR.
1 SCR	2000	50	37.8	920
1¼ SCR	3000	50	61.0	1170
1½ SCR	4000	50	75.6	1840
2 SCR	8000	25	151.0	3570
2½ SCR	12,900	15	244.0	4500
3 SCR	17,000	10	320.0	6600
4 FLG	27,000	8	510.0	8900
6 FLG	55,000	5	1035	17,800



CHOICE OF TWO ACTUATORS:

V-116 MANUAL RESET, with lever action—90° handle travel. Held open electrically, spring closed on power interruption.

H-117 HYDRAMOTOR, electric reset, with either fixed opening speed or adjustable opening speed regulated to design of equipment.

For more facts circle 239 on Reader Service card, p 103

LOUIS N ROWLEY, EDITOR • MAY 1960 • ESTABLISHED 1882 **Power**

Energy Systems Engineering

The three words above should be of more than passing interest to POWER readers. Better than any others, I believe, they describe the field with which we are all connected—a field whose dynamic nature is amply demonstrated in the *TD* report beginning on p 61 of this issue.

Deliberating about the right words to identify something is typically the province of editors. And we *have* been concerned about the seeming inadequacies of the terms used to describe the engineers who read POWER and the professional field in which they are engaged. For many years, we have written of "power engineers," all the while being increasingly aware that to many it must carry a narrow connotation and fail to reflect the wide-ranging interests and highly technical skills involved in the important task of energizing production and providing a controlled environment for industrial and commercial activity. The term "power-service engineer" was little better.

Recently we decided to come to grips with this problem, to see if we couldn't devise a phrase that would fully characterize the work done by our readers and the area of technology covered in POWER's pages. An objective look revealed immediately that our major concern is the manipulation of energy in all its various forms—the generation, conversion, control, transmission and application of electrical energy, heat energy, fluid energy, mechanical energy.

And, more specifically, we are concerned with energy from a "systems-engineering" point of view. To greater or lesser degrees we are all involved in designing and building, or operating and maintaining, the complex systems by which energy is put to a host of useful purposes in the modern world.

In all of the systems with which we deal—electrical, steam, compressed-gas, air-conditioning, refrigeration and fluid-handling systems—energy is the common denominator. These are "energy systems" and as such they share a common technology and demand similar engineering skills. And while energy systems are *alike* in these respects, they are basically *unlike* other types of production facilities and equipment complexes.

In the truest sense, each energy system is a manufacturing entity within itself, having as its end product energy in the usable forms desired by its "customers." For example, a utility-company energy system has many customers, but only a single product — electricity. In contrast, an industrial energy system has only one customer—the establishment it serves—but it supplies a variety of products such as electricity, steam, conditioned air, treated water, etc.

The design and management of these systems *is* energy-systems engineering. And in those three words we believe we have an apt description of our common field of interest, one that properly characterizes its breadth, its importance and its unique technical nature. We hope you will agree and more and more will come to think of yourselves as "energy-system engineers" and your field (which is ours) as "energy-systems engineering."

For 99 out of 100...

Selection of

can be as simple as selection of Bronze and Iron Valves

HOW to keep it simple? Don't let the wide selection of stainless steel alloys "throw you"!

Most of the alloy specs were developed to meet certain highly specialized and rather uncommon needs. Only 1 out of 100 valve users can make practical use of many of the alloys. *Actually, just two or three of the different available alloys will give a big majority of valve users all they want and need.*

You can judge DESIGN differences between the various "makes" exactly as you do it with Bronze and Iron valves. Look them over and compare. Basically, of course, a Stainless Steel valve is designed and constructed very much like other valves.

What is left to worry about in addition to Material and Design? The same factors you consider in buying ANY valves for long, dependable performance: Are the valves made merely good enough, or to a standard that demands an extra-measure of quality? How good are the castings? How precise and perfect is the machining? How rigid is the inspection and testing during manufacture? These are the factors which specs can't cover. Some of them you can't see when you look at the valve. But you KNOW how to make sure they measure-up to peak standards. You know that the name JENKINS VALVES and the famous Jenkins DIAMOND trademark have been the highest assurance of quality for nearly a century.

Specify *"Jenkins"* as well as the metal alloy to assure fullest satisfaction. Your Jenkins Distributor has patterns and alloys to satisfy most industrial needs. Of course, they meet valve industry specifications and the high standards established by leading users of stainless steel valves. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS VALVES

JENKINS SINCE 1864

Jenkins Bros

Stainless Steel Valves

☐ Send the new stainless steel valve catalog

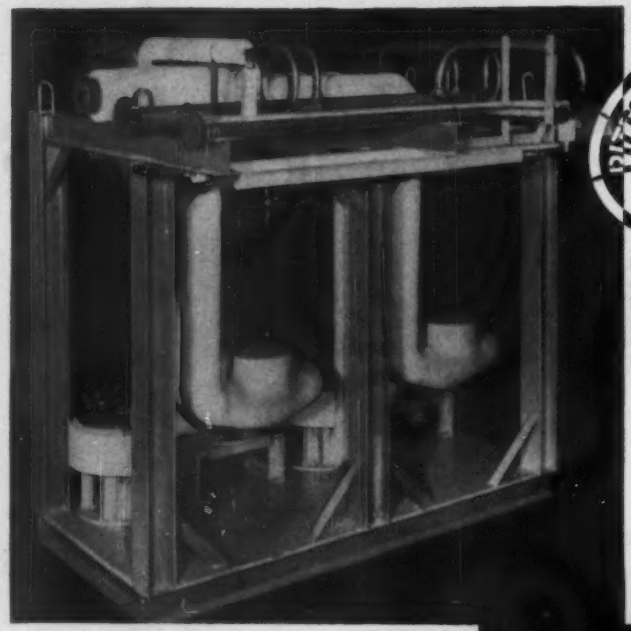
☐ Have a representative call on me

TEAR OFF AND MAIL

NAME & TITLE.....

COMPANY.....

ADDRESS.....

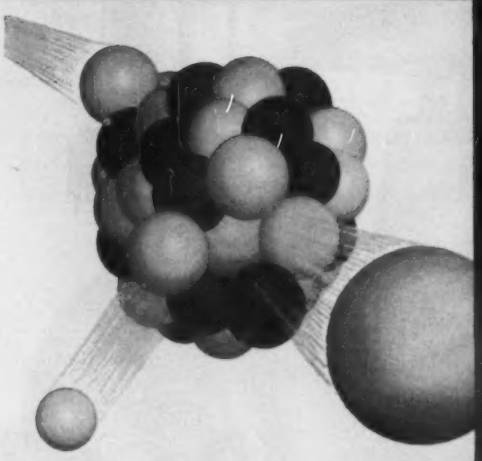


PITTSBURGH PIPING NUCLEONICS JOB NU-4017

One of a battery of stainless steel test loops fabricated at Pittsburgh Piping. Shown insulated; ready for shipment.

Stainless steel de-mineralizers—larger unit is 14" in diameter; its wall thickness is 1½".

PITTSBURGH PIPING NUCLEONICS JOB NU-1621



PP-39

Fabricated by Pittsburgh Piping for Nucleonics

The stainless steel test loop and the de-mineralizers shown above are typical of the nucleonic piping work that goes through Pittsburgh Piping shops.

This type of fabrication is a "natural" for us. We pioneered the application of austenitic steel piping materials for central stations operating at 1050°F and above, and fabricated piping for America's first atomic-powered submarine and central station. Today we are producing a wide variety of piping components for leading builders of nuclear energy installations. We invite you to inspect our plant, meet our people, and use our facilities on your nucleonic jobs.

PIONEER FABRICATOR OF HIGH PRESSURE PIPING FOR NUCLEONICS

Pittsburgh Piping AND EQUIPMENT COMPANY
158 40th STREET • PITTSBURGH 1, PA.

Atlanta . . . Whitehead Building
Chicago . . Peoples Gas Building
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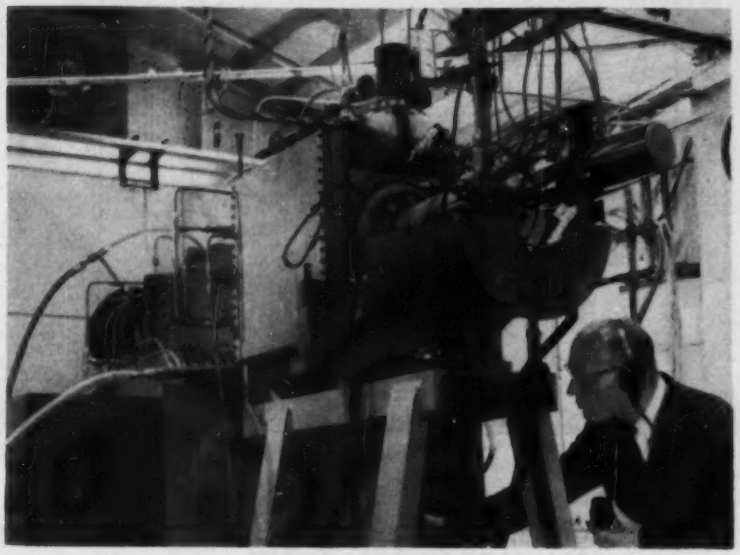
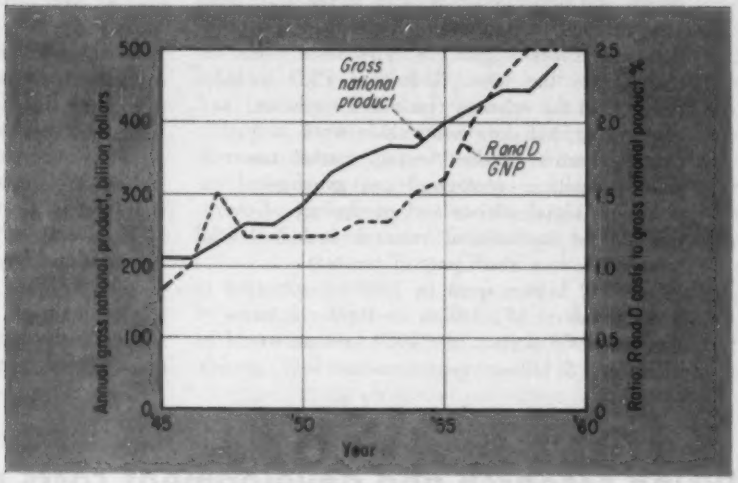
Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge

a Today's Development report



Magnetohydrodynamic generator typifies...

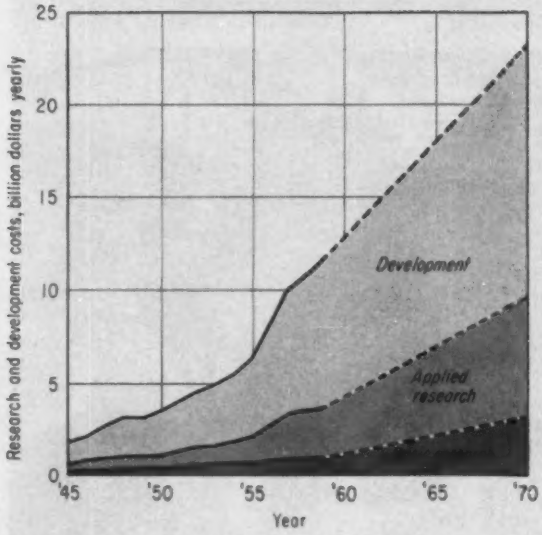


boost given a growing economy as . . .

Research shapes the future of Energy Systems Engineering

By B G A SKROTZKI
Associate Editor

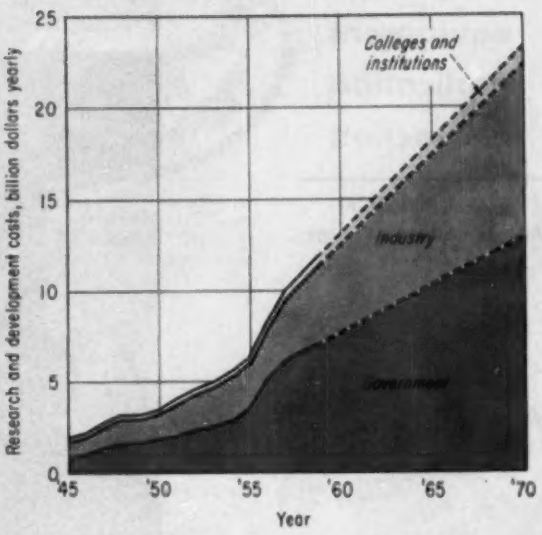
Research, such as Westinghouse's new MHD generator above, has been adopted as a firm business policy—because it pays. Our booming economy as measured by the Gross National Product (GNP), graph above, has been accelerated by increasing efforts in research and development, and points to changing practices coming in energy-systems engineering. The increasing percentage of GNP devoted to R&D, less than 1% in 1945 rising to 2.5% in 1959, points up business recognition of this fact. continued



What R&D money buys

McGraw-Hill's Dept of Economics survey of research and development activity in the U.S. from 1945 to 1959 shows that development of new products and processes gets the lion's share, basic research gets the least. Industrial R&D includes research in the sciences (including medicine) and engineering, but does not include work in quality control, routine product testing, market research, sales promotion, geological and geophysical exploration, social science and psychology. Governmental and institutional research includes social sciences, a very small part of the total.

The $12 billion spent in 1959 are expected to grow to about $22 billion in 1969. In terms of constant 1959 dollars, the 1969 forecast would be about $17.5 billion, approximately 46% growth.



Who supplies R&D money?

World War II and the subsequent cold war put the Federal Government into research and development in a big way—as a sponsor. Victories go to those who see the need for finding new ways to lick the enemy. Paradoxically, history shows that in many cases R&D for war has developed profound benefits for civilian activities later on.

Government supplied about 60% of R&D money in 1959, industry about 35%. Some see an ominous rise in government control in the increasing R&D initiative which has a far-reaching effect on our national economy. While government sponsorship of R&D is expected to grow in the future, the share will shrink, slightly. In 1969 government will supply about 56% and industry 40%, M-H predicts; defense needs keep the government's share high.

Rising research and development costs pay out in improved

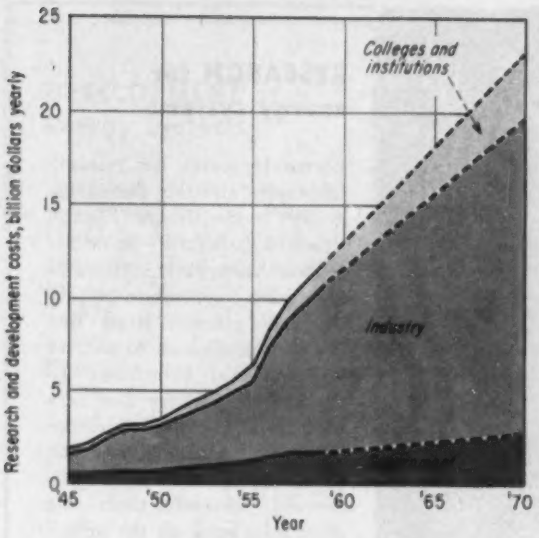
One McGraw-Hill survey shows that in 1960 new products, unknown in 1956, will account for at least 15% of the total sales of the chemical, electrical, machinery and transport equipment industries. In consumer goods about 10% of 1960 sales will be in products not predicted in 1956. The heavy industries especially have learned the dollar value that the researcher offers as a medium-term—about 10-year—investment.

Recently R&D in the energy-systems area has sought ways of eliminating the heat-power cycle in producing electric energy from heat. Today we have new methods such as thermoelectrics and solar cells already doing special jobs; we can soon expect applications of thermionics, fuel cells and magnetohydrodynamics. But these are only a small part of the ever-exciting story of R&D in energy-systems engineering.

History of research

At the dawn of time we probably had men that wondered about things, things that had nothing to offer in solving the immediate problems of the day. To them we owe the advancement of civilization—they were not satisfied with things "as they are." A few men in the 18th century probably began the activity we formally recognize today as research. Many of these men were scholars by vocation, some were industrialists with a strong avocation in science, some were physicians seeking better understanding of the ills of mankind.

At that time there did not seem to be any urge to find commercial advantage in the uncovering of new knowledge. These men laid the foun-



Federal Government R&D budget

Million dollars

Agency	Resch	Devel	Total
Department of Defense	595	4789	5581
Atomic Energy Commission	178	595	773
National Aeronautics and Space Administration	164	139	303
Department of Health, Education and Welfare	242	2	244
Department of Agriculture	114	6	119
All other agencies	151	61	212
Totals	1444	5592	7232

Analysis of government research budget

Science	Million dollars	Percent
Biological	93	6
Medical	276	20
Agricultural	63	4
Life sciences	432	30
Physical (proper)	502	35
Mathematical	48	3
Engineering	414	29
Physical sciences	964	67
Social sciences	48	3
Total research	1444	100

Who does R&D work?

Despite the large monetary contribution by the Federal Government to R&D we see here that industry does most of the work by far. On the other hand, colleges and nonprofit research institutions do much more of the work than their monetary contributions indicate. Their work is largely underwritten by government contract with an appreciable part authorized by industrial interests. The government does only a small part of the R&D work it finances—much of it is farmed out to industrial contractors. Government does have its own laboratories typified by Bureau of Standards, Office of Naval Research, Office of Air Research, National Advisory Committee for Aeronautics and others. Industry does about 75% of all the work in research and development, measured monetarily.

What each science gets

These tables show that the Department of Defense gets about 78% of the total R&D money allocated by the Federal Government. Sliced another way, development takes 77% of the total money, showing the long tough road of turning ideas into hardware. But development feeds on basic and applied research which form the seeds of national and industrial progress. Here the lower table shows that the physical sciences get two-thirds of the total research budget. In a finer breakdown we see that the physical sciences (proper), which include chemistry, nuclear physics, mechanics, light, heat, electricity, magnetism, earth sciences, gases and related topics, receive about 35% of the total. This division of money shows the importance of the engineering area to the welfare of our nation as a whole.

products and processes, assure high growth potential

dation for the field of physics or engineering sciences as we call them today.

In the latter half of the last century industry began to exercise its young muscles, and we have seen rapid growth of its activity since. The late 1800's and early 1900's were the era of the garret and cellar inventors. These were a breed of men that clung tenaciously to their dreams and struggled desperately against frustration of their fulfillment.

Many of these men failed, some for lack of understanding the materials and forces they were dealing with, others for lack of financing, some because they were way ahead of their time and could find no backers.

Some of these men won handsomely —if not financially, then at least technically. Names like Pelton, DeLaval, Corliss, Babcock, Wilcox, Ashcroft, Skinner, Otto, de Rochas, Gramme, Siemens, Brush, Thomson, Rankine, Edison, Westinghouse, Tesla, Carrier, Sprague, Worthington, Linde, typify technical developments that were successfully commercialized from basic knowledge of materials and energy.

Much of their work had been cut and try because information was not classified or available in a form that could be used easily. Principles of design were just emerging as a rational tool for the handmaiden of research—development. Experimentation was a basic philosophy in early development work, and still is, but today's catalog of material properties helps cut down much of the drudgery of experimentation, letting us arrive at our goals much earlier in a project. Since specific objective results cannot be assured, research must be re-

RESEARCH for energy systems

Glassware marks the research laboratory and this thermionic project in the General Electric Research Laboratory is no exception. These early versions of thermionic converters typify the many-pronged attack that researchers often use to uncover new physical principles. To check their findings they may have to set up alternate equipment arrangements that help to prove the principle newly discovered. Successful thermionic generators work on the principle that heat speeds up electrons, driving the free electrons toward the colder end of a 2-plate arrangement. Heat-activated electrons form useful electric current as output.

R&D findings promise to change future practice of art of

garded as a business risk. Turning a learned man loose to satisfy his curiosity in a given area of scientific phenomena, without immediate thought of profit for his employer, has proved the paradox again and again of turning up gold where none was sought. The researcher personifies the fable of serendipity, looking for one thing and finding something else of great value. Employers of researchers must be astute men; they must have the ability to recognize the business value of information they were not looking for.

A 1958 McGraw-Hill survey of manufacturers showed that 39% expected their R&D to pay off in less than three years; 52% expected it in less than six years and only 9% expected it in more than six years. The latter group, it's interesting to note, is roughly the proportion of business firms that engage in basic research.

Research advances

Research touches new products, processes, materials, principles and concepts—the whole fabric of engineering. One of the newest areas of research deals with *molecular electronics*, the treatment of materials so they will act as a series of diodes, resistors, capacitors, tubes and transistors. Whole electronic systems can be grown in crystal form on the basis of this new knowledge.

Energy-systems engineering gets increasing attention as we strive to improve performance of heat cycles to produce shaft power. Improvement no longer depends only on bettering the functions of individual cycle equipment. Interdependence of all elements demands studying the effect of changes on all components and balancing them against each other to achieve best overall performance.

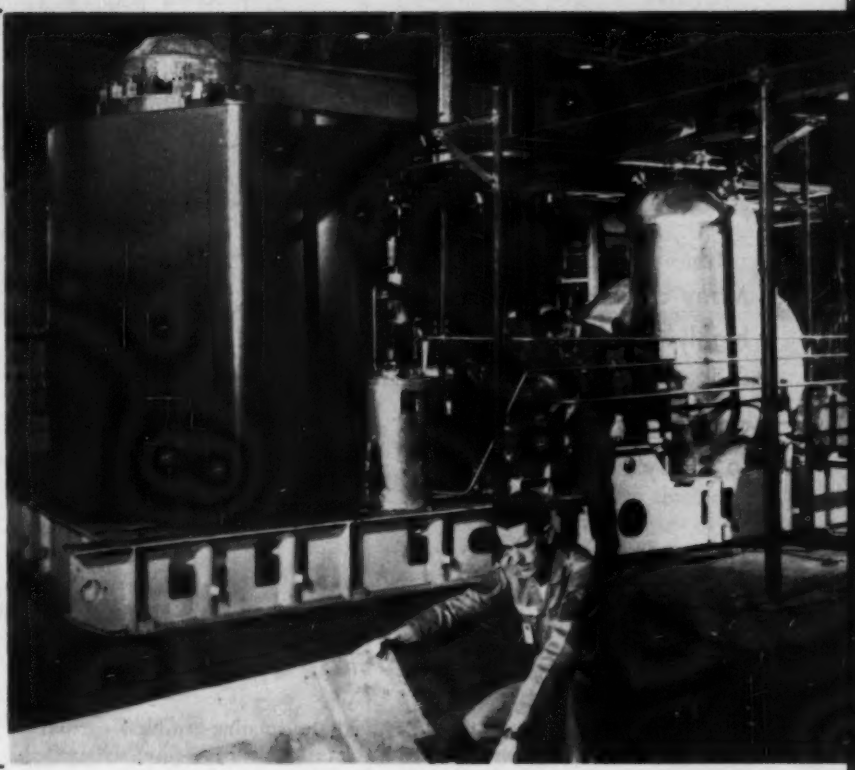
The jump to superpressure cycles needed long research into: water treatment, metal behavior at high temperatures and pressures, cycle controls of water and gas flows. Full-scale plants are now building or running.

A 3-year project at Southwest Research Institute seeks to improve pressure-vessel design by reducing the factor of safety and working the metal closer to its ultimate strength. This can be done by developing understanding of plastic fatigue behavior, more rational stress analysis.

Much work has been done on improving equipment functions. Aerodynamic research has yielded data to improve vapor and gas flow through steam- and gas-turbine blading and buckets, and fans and blowers. This also helps improve flow paths through boiler tube banks, heat exchangers, dust collectors, gas ducting, exhaust hoods and related apparatus.

DEVELOPMENT of energy systems

Special situations often speed the development of full-scale prototypes like this PM-2A nuclear-power plant, prefabricated by ALCO Products, Inc. The primary system of this plant mounts on a skid and can be transported by Army cargo planes. Reactor in its radiation shield at left heats boiler at far right behind vertical pressurizer. Army engineers will install this plant, built in 27 packages, in Camp Century, Greenland, as the source of electric power and space heating. This project demonstrates the application of new principles proved out in 1940 to solve a practical problem of providing energy services.



applying Energy Systems Engineering

Continuing thermodynamic research pins down more accurate data on liquids, vapors and gases. These data will allow more direct design approaches in boilers, turbines, pumps, heaters, compressors, fans, blowers, heating and ventilating systems, air-conditioning, refrigerating systems and internal-combustion engines.

Materials research investigates metals, plastics, refractories, fluids, chemicals, fibers, with the intent of further defining their properties, such as strength, corrosion resistance, heat conduction, electric conduction, flexibility, viscosity, creep and others. This work hopes to find better materials to do specific jobs at lower cost.

Electrical apparatus probably enjoys one of the most continuous efforts at basic improvement. Here we find efforts producing better lighting, motors with improved operating characteristics, generators made more compact by inner cooling, more economical distribution facilities, better and cheaper switching, more compact transformers, more extensive control systems that will speed the day of total automation in power plant and factory.

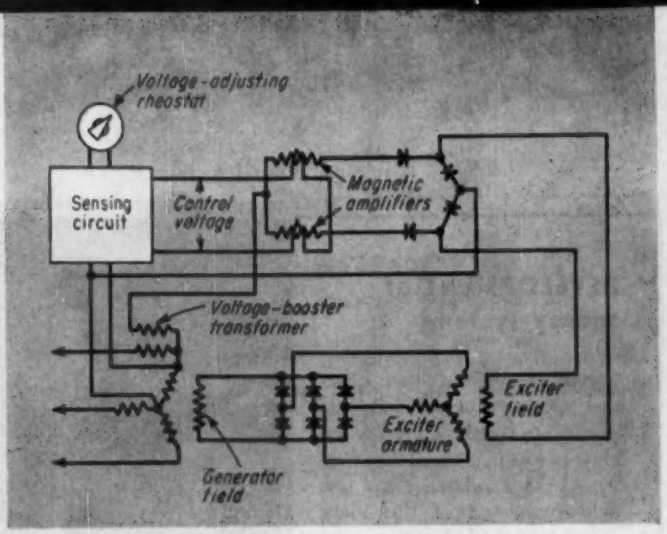
Research in nuclear fission and fusion continues to claim the most popular attention, and probably the largest investment in funds. Though progress up to now promises no economic breakthroughs in power generation, the political implications that have been attached to the atom assure its receiving government financial support into the foreseeable future. A side effect has been the steady reduction in predictions of the share of national energy output in the future that will be produced by nuclear reactors. This reflects the rising difficulty that the atom has in meeting economic objectives, here and in Europe.

Energy systems run into special problems of their own that require continuing research and development. Fuels, water and lubricants prove indispensable to system functioning, but they develop shortcomings that interfere with economical operation. Chemical additives are being studied to reduce furnace slagging and fireside corrosion of economizers and air heaters. Water research continues to develop treatments that will reduce operating costs and improve physical behavior in a power or processing cycle. Water for working fluid in a cycle and water for cooling each pose their own problems, demanding rigorous attention to finding solutions.

Lubricants indispensable to rotating machinery have received concentrated efforts to improve their life, fire resistance and applicability range. Achieving these ends can reduce the overall costs.

By FOREST SMITH
Electric Machinery Mfg Company

Many applications require a highly stable terminal voltage. Considering generator and exciter as a unit has led to today's design of . . .



PACKAGED GENERATOR includes brushless exciter and static voltage regulator. Generator field is controlled indirectly by regulator, through exciter field

Packaged excitation systems

Until the last ten years or so the most common excitation system consisted of rotating dc exciters direct connected (or belted) to the generator and some form of rheostatic voltage regulator to alter exciter's field resistance. Specifications governing regulation of ac-generator voltage and degree of response under transient conditions were usually quite liberal. Today, many applications require a high quality of terminal-voltage stability. The rapidly expanding computer field is an example: often present-day contracts for precise power units require a comprehensive voltage analysis.

As specs become tighter, they increase factors to be considered in design of the complete unit—the generator and its excitation system. Fortunately, new materials and highly developed control components make possible a wider variety of generator designs and excitation systems.

Table 1, right, outlines high-quality-voltage considerations, and indicates which part of system has prime responsibility for meeting specified performance. Table 2 classifies some types of exciters now available for incorporation in an excitation system. Of these, we'll discuss only the static and the rotating-brushless exciter.

Static exciters are self-excited. That is, power to the generator field is supplied through the static exciter from generator's terminal voltage. Power feedback is a function of generator-field excitation necessary to maintain required generator voltage for various load conditions encountered. A regulator that senses generator terminal voltage establishes exciter control.

Application of a basic static-exciter system requires careful consideration of customer's requirements where generator overload conditions exist. Certain military specifications for 400-cycle generators require application of twice rated kva load as a performance demonstration. The self-excited system is readily adaptable to this application and has been used on generators rated to 250 kva, 400 cycles. Of course, if customer needs a sustained short-circuit current the system will obviously fail, since generator-field current will collapse with zero terminal voltage. In applications to 60-cycle generators, inherent limitations on overloads are considerably more restricted; in general this system can't be used.

One method of overcoming some limitations in the basic self-excited system adds a boost transformer. Boost-transformer primary is excited by current supplied to generator load. Boost transformer adds a component of voltage (secondary of transformer) to generator voltage as load is applied to generator.

Magnitude and phase angle of component voltage in relation to generator voltage is a function of load current, load's power factor and saturation level of the transformer. For unity-power-factor load current, boost voltage is at right angles to generator voltage, raising input-voltage level to the static exciter only to a slight extent.

For zero-power-factor load current, boost voltage is in phase and adds directly to generator voltage, raising voltage applied to the static exciter to a much higher value. Boost voltage adding directly to the generator voltage is a desirable answer to the maximum-excitation demands of motor starting. With proper design this circuit will successfully maintain a short-circuit current.

Successful applications of boost transformers to static exciters are made on 50- to 60-cycle generators as well as 400-cycle units. Present

1 Which component meets performance specs?

	Generator	Exciter	Regulator
Wave shape, various load conditions	x		
Total harmonic content	x		
Maximum single harmonic	x		
Crest factor	x		
Wave-form factor	x		
Deviation factor	x		
Transient response, specified loads			
Maximum voltage dip	x	x	
Maximum voltage overshoot	x	x	
Recovery time to given % rated voltage	x	x	
Voltage to remain within certain % of rated upon recovery			x
Steady state, fixed load conditions			
Max voltage, modulation or deviation from rated; frequency of deviation			x
Voltage drift with ambient temp			x
Voltage drift with time			x
Voltage regulation			
Given load range			x
Given power-factor range			x
Given ambient-temp range			x
Regulation based on single-phase or average 3-phase sensing			x
Phase-voltage balance—unbalanced, no load	x		

2 Modern exciters may be static or rotating

- Static exciter
  - Power from ac-generator terminal voltage
  - Power from ac-generator terminal voltage and generator line current
- Rotating (single-stage amplifier) exciter
  - Conventional-commutator dc exciter
    - Self excited
    - Excited from ac-generator terminal voltage
    - Excited from ac-generator terminal voltage and gen line current
  - Ac brushless exciter
    - Excited from ac-generator terminal voltage
    - Excited from ac-generator terminal voltage and gen line current
- Rotating amplifiers (two or more stages)

3 Voltage regulation involves these factors

	Reference source	Feedback signal	Preamplifier	Stabilizing
Transient voltage to remain within certain limit on recovery				x
Voltage modulation				x
Voltage drift with ambient temp	x			
Voltage drift with time	x			
Regulation* of voltage with load			x	
Voltage adjustment range		x		
Frequency range	x			
Regulation over ambient-temp range			x	
Average regulation		x		
Cross-current compensation		x		
Line-drop compensation		x		
Generator terminal-voltage droop characteristic		x		

*Regulation is determined by total amplification in loop: preamplifier gain × exciter gain × ac-generator gain. Exciter and ac-generator gains are assumed to be more or less fixed; preamplifier gain can be varied at will

applications are on generators rated as high as 1875 kva, 60 cycle.

Fast response to transient load conditions is a major feature of the static-exciter boost-transformer combination. A fast transient response cuts voltage dip, overshoot and time of recovery. In effect, a smaller generator can sometimes be used. Wave form is primarily determined by the ac generator. But when a static exciter is used for excitation, its firing action modifies generator wave form. Line filters may be needed to meet output specifications.

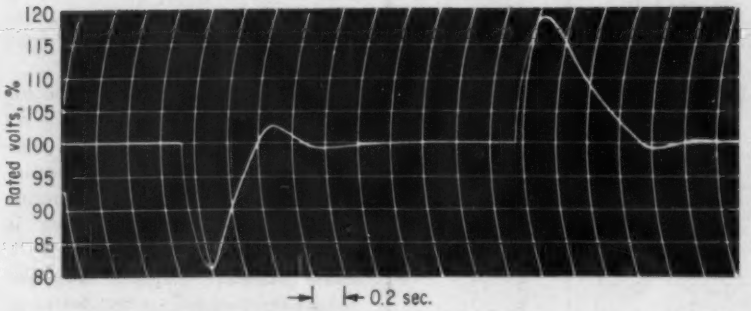
Common components of static exciters are self-saturating magnetic reactors combined with either a selenium, germanium or silicon-junction rectifier. Combination of saturable reactor in series with rectifier is called a magnetic amplifier. A 3-phase full-wave magnetic amplifier has six reactors and six rectifier junctions; flow of power through the magnetic amplifier is controlled by changing effective impedance of the reactors.

Brushless exciter is a modification of a rotating dc exciter, with a rotating rectifier replacing the commutator. All brushes are eliminated from generator's rotor. Power to excite the ac-generator field is generated in the rotating-exciter armature and then converted to dc by the rectifier. Field excitation of the brushless exciter requires just a small amount of power, and this can readily be supplied by voltage regulator. Exciter-field power has little or no effect on generator wave form.

Field-time constant of a standard-design brushless exciter is considerably longer than that of a static magnetic-amplifier exciter (although special designs have reduced time). Because of the longer time constant, response to generator load changes is slower. Response can be improved by adding a small boost transformer to voltage-regulator input. It functions like the static-exciter boost transformer, but on a considerably smaller power scale.

Inherent advantages of a brushless exciter are removal of commutator and brush and their maintenance. Unit is arc-free, readily adapted for explosively hazardous locations. Brushless generators are commonly applied up to 200 kva; this can be extended to much higher ratings (see POWER, April 1960, pp 89-91).

Voltage regulator's overall function is comparing a portion of the ac-generator terminal voltage with a reference, the difference being amplified and the resulting signal applied to the exciter (and in turn to the ac generator) in direction that minimizes the difference with least voltage instability. Thus there are



TEST RESULTS on 1875-kva 60-cps generator with static exciter and regulator, adding boost transformer; 1.0-pu impedance load, about zero pf, was instantly applied, removed

four basic requirements for a regulator: reference, feedback signal, preamplifier (one or more) and stabilizing. Each control area is responsible for portions of the voltage specifications as shown in Table 3 (assuming static regulator is used).

The reference in static voltage regulators, V_R, has a predetermined fixed value. Typical characteristic of a reference element: a certain level of applied voltage is reached, above which an avalanche of current flows through the element or reference circuit. Regulator's accuracy is no better than the quality of the reference. This system is open-loop, looking from reference to generator voltage.

Desirable reference-voltage characteristics include independence of frequency, ambient temperature and aging effects. Generally speaking, aging is of little consideration except with a battery reference. Aging in other types is readily corrected in feedback-signal network by voltage-adjusting rheostat.

References that require dc voltage for operation are independent of frequency. Two such types are the VR tube and the silicon zener diode. Both can be made practically independent of temperatures. Small size and rugged construction presently favor the silicon zener.

Another class of references requires an ac-voltage input, such as a magnetic reference that can't support ac voltage above a certain level due to iron saturation. For constant-speed applications this reference is readily applied, but for variable-speed sets, frequency compensation is required, since voltage saturation level is directly proportional to frequency. Dc and ac references are static in nature; a common nonstatic reference would be a spring.

Feedback signal, V_{FB}, in its simplest form is a percentage of the generator terminal voltage. Percentage is determined by ratio of reference voltage V_R to generator voltage. Using a simple resistor network and a rheostat provides a method of adjusting this ratio to required voltage range.

In the feedback-signal network, modifications are made for cross-current compensation, line-drop compensation, generator voltage droop proportional to line current, 3-phase and high-phase sensing. First three produce signals that add to or subtract from generator signal as load is applied. Result raises or lowers the generator terminal voltage with load as required. Modifying the feedback signal this way doesn't affect actual voltage regulation.

Error signal $V_R - V_{FB}$ has little meaning unless its power level is raised or amplified. Required increase in level is dictated by degree of regulation desired at generator terminals, accuracy of generator voltage and initial level of error signal. In a closed-loop system, ratio of generator-terminal voltage to the reference V_{FB} is expressed:

$$\frac{V_{FB}}{V_R} = \frac{G}{1 + GK}$$

where V_{FB} is proportional to generator volts

V_R = reference volts

G = system gain

K = a constant that can equal 1

If G is large, ratio $\frac{V_{FB}}{V_R}$ is a constant. This means that, within limits, regulation and accuracy of generator voltage can be made independent of system-gain variations. System gain can vary as a result of aging, substitution of amplifiers, heating in exciter and generator, etc.

A choice of amplifiers may be used in a regulator. Three are magnetic amplifiers, vacuum tubes and transistors. Vacuum tube is limited because of mechanical vibration and need for filament supplies. A transistor is probably first choice because of its low-level input, ease of application, rugged construction and small size. A transistor may readily be cascaded with another transistor or magnetic amplifier for high levels of gain.

Instability is a continuous voltage swing or oscillation readily observed on a voltmeter, which may or may not disappear with time. A closed-loop system containing two or more time delays will be unstable above a certain gain level if no correction is made for this condition.

To describe a system as being "stable" is not sufficient; you can have a stable system that is still completely unacceptable. Following a sudden load transient, a voltage oscillation may appear that is slow in disappearing. Rate at which a system becomes stable after a load change is therefore important, and can be specified in various ways. You might, for example, state that following a given load change, recovery voltage must remain within a specific value of rated voltage in a specified time.

The other criterion for stability is voltage modulation or voltage deviation permitted for a given fixed-load condition. Deviation in this case is not related to temperature effects; think of it as random fluctuations that might be present.

A method of stabilizing the systems we've described is to feed back from the exciter-output voltage a signal proportional to rate of change of exciter voltage. A stabilizing transformer or resistor-condenser network usually handles the feedback. Signal feedback is usually introduced in output of the error-detection circuit or input to the preamplifier.

New data systems will match your plant's needs

- Compact loggers trim their size and complexity for pure data gathering
- Plant monitors emphasize safe operation and less-conventional plant control-room instruments
- Portable loggers supply test data for large plants and spread-out systems

By L E STEWART, Associate Editor

In the last few years plant instrumentation has changed considerably, keeping pace with increasing size and complexity of energy systems. As centralized controls and instruments became mammoth systems and more and more data poured into one location, special data-logging systems appeared to supplement conventional instruments.

Today, as the functions and capabilities of data systems become better understood, you will find equipment is being modified and expanded to follow three major trends in data-system use. In this article, POWER surveys these trends, current practice and future goals of users and designers. You can apply this information to planning future data systems for new or existing plants.

Compact systems for mass data logging fill a need which has arisen from problems of the modern plant. Almost universal use of central control rooms brought order to the random instrumentation and control systems once found. But this was not an unmixed blessing. Centralized control rooms often included controls for several units—in some cases, too many units. In addition, efforts to bring all information to one central point resulted in too much information flowing into and through the control room. First cost also suffered since many plants could not shoehorn control rooms and accompanying cubicles into a conventional building layout.

To solve these problems of oversized control rooms and more data than operators could cope with, modern data systems went into control rooms to operate in parallel with existing instrumentation. Some of these were not total successes due to a misapplication of data-gathering concepts and some misconceptions of the true usefulness of data systems. They were asked to do too much.

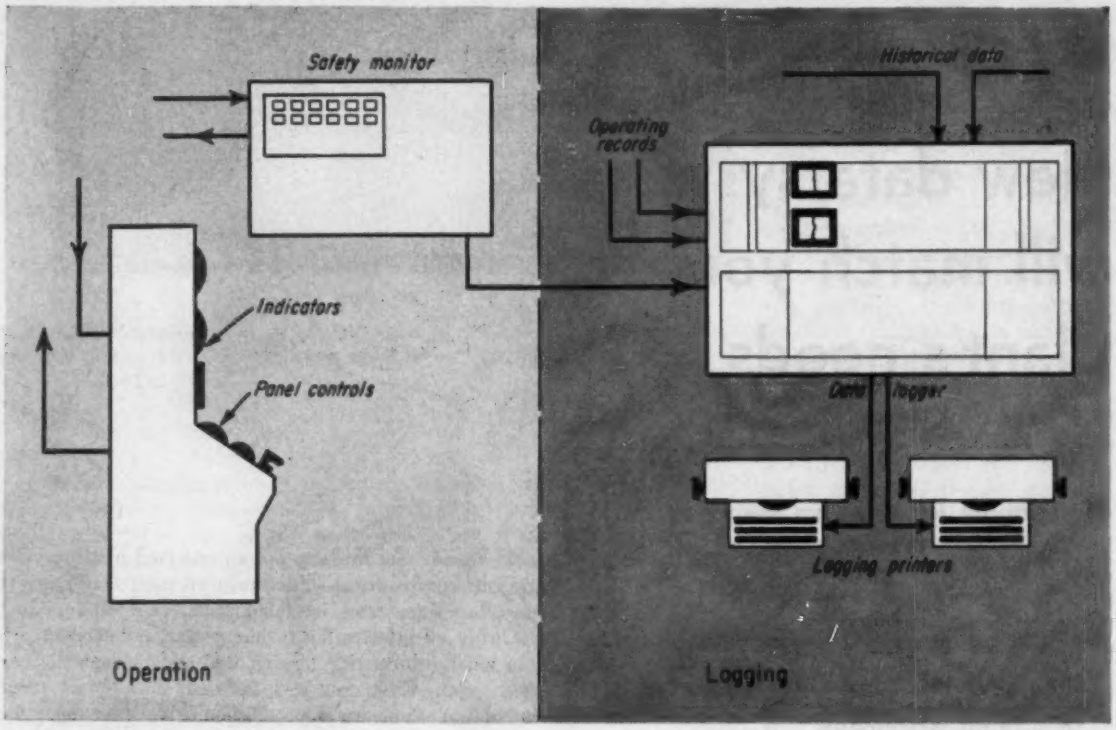
Now, energy-systems engineers have experience in operation and application of data loggers; we find a new generation of designs coming into plants. Instead of merely operating in parallel with existing instrumentation to save the nuisance of manual data logging, new data systems will truly pay off by supplanting marginal recorders and instruments as well as all historical-data recorders. Aside from direct instrument-cost savings, compact data loggers will reduce control-room area and possibly save in building cost where a larger control room might force expansion of overall building size.

Three basic concepts direct trends in data-logger system design: (1) Pure information gatherers replace some recorders, compile data and often perform data-reduction operations. (2) True system monitors gather data, calculate performance, check and indicate trends which reduce unit performance, monitor unit safety. (3) Portable data-logging equipment fills need for specialty test and performance instruments where built-in systems cannot be justified on basis of improved efficiency.

Since each of the three concepts presents unique design problems, equipment to fill the needs of a particular system differs radically. Next three pages compare design, performance and operating problems which developed a need for specific data-information systems.

continued

Unit data loggers handle operating records, have no direct effect on operation



DATA-GATHERING setup scans historical data and operating points to collect complete record of unit. Logging printers and trend charts supply raw data and calculated values for analysis of unit. Output data may be used for calculating incremental-loading cost

Today's loggers represent better design and better application of original logging concepts. Prime importance is given to reducing nonessential instrumentation and freeing plant operators from the menial and time-consuming tasks of data logging by hand.

Basic system, shown above, functions outside of the operating area. Although operating data is logged, it is not displayed as a day-by-day operating guide, but is available for engineering evaluation of past performance, trouble-shooting and investigations of transient conditions, startup, shutdown or load swings.

Logger functions usually include straight data gathering, some data reduction and possibly printout of alarm conditions. In many cases separate safety-monitor circuits handle all plant alarm conditions and logger merely records condition relayed by monitor. Where data logger does handle some alarm conditions, such as high or low temperatures, they are normally items which operators must recognize and correct within reasonable time limits. Safety trips and automatic limit controls usually remain as separate operating-area equipment.

Data sampling and logging occurs in a sequential pattern with each data point sampled and recorded in turn. Rates may run about five points per second. Logging speed normally is set by printout devices; user must balance sharply increasing cost of higher-speed output devices against his needs and possible economic gain from faster recording.

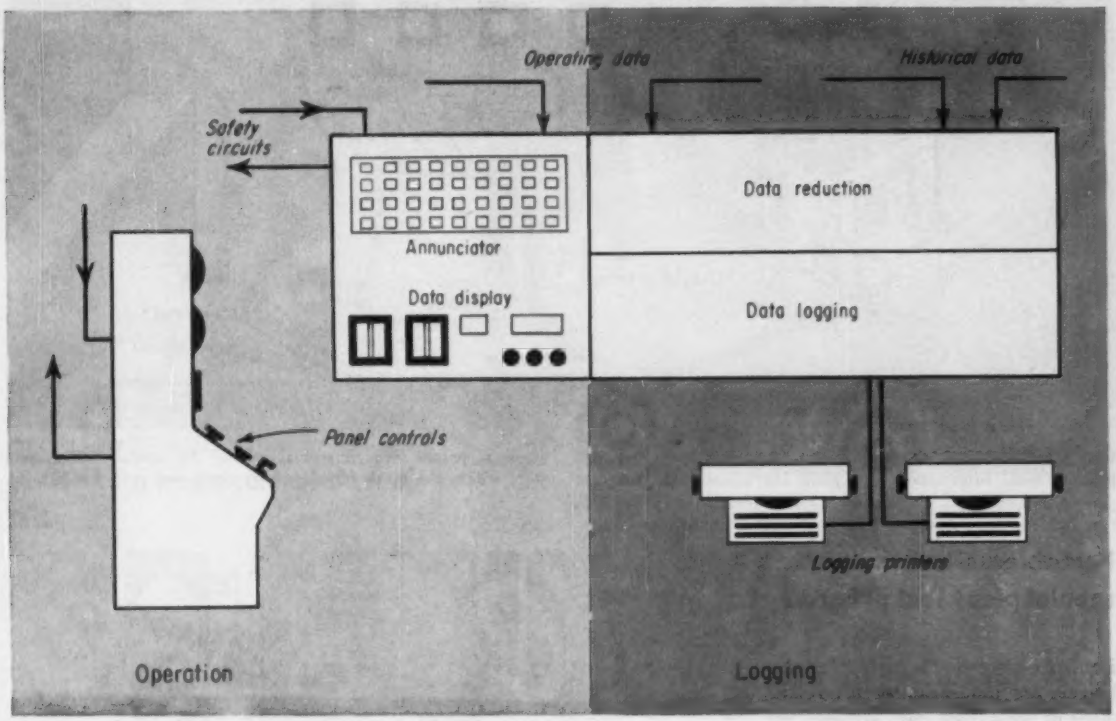
Most data-logging systems include some form of memory for temporary storage of data. This frees sampling circuits for scanning safety circuits and other data points.

Data reduction requires computing equipment, either analog or digital. Data from energy systems, however, represents a relatively small input compared to business operations. Most performance calculations involved are straightforward so that extensive computing equipment isn't needed. Operating within these capacity limits, future data loggers seem to be headed toward smaller size and simpler or less-extensive equipment. There are indications that some calculated results, power-plant heat rate, for instance, will be logged in digital and chart form. The mathematical tools for continuous heat-rate calculation are in development stage today.

Logger development for the new types of units came in answer to problems of plants still capable of human operation. Under these circumstances, logging equipment is designed to release operators for equipment supervision and decision-making. As side effects, operating companies have found logged data invaluable in scheduling maintenance as well as an aid in preparing startup and shutdown instructions for new plant power systems.

Plant monitors introduce data-logging equipment to the actual operating area. Design evolution stemmed from the need to supplement human operators in large and complex control setups. As equipment size in-

Plant-performance monitors check system safety, give operator data he needs



SAFETY-MONITOR portion of data system includes continuous scanning of all safety circuits through integrated monitor-logger circuits. Data display of normal or emergency reading appears at control panel so operator need not move from critical controls

creases and more-complicated control functions are added on top of already-complex instrumentation, it becomes physically impossible for humans to react quickly and correctly every time. A look at cost estimates for repair of plant accidents proves that preventing even one major accident would return the entire investment in plant monitors several times over. With operating safety as a major design factor, new plant monitors stress system dependability and flexible data presentation to suit requirements of a human operator.

Data display appears at two locations in monitor system. Recording printout takes the form of normal logged data — information will be used for the same purposes as basic data-logger output. Second, and probably more important, display will occur on or directly adjacent to operating control panel (see drawing above). It is presented as chart trend records or digital display for fast, accurate readings of any data point. Data-at-fingertips aspect permits operator to scan the entire unit without moving from his important controls.

Fewer instruments are needed for control of a monitored unit. Since all data is on visual display, only critical operating records appear on panel.

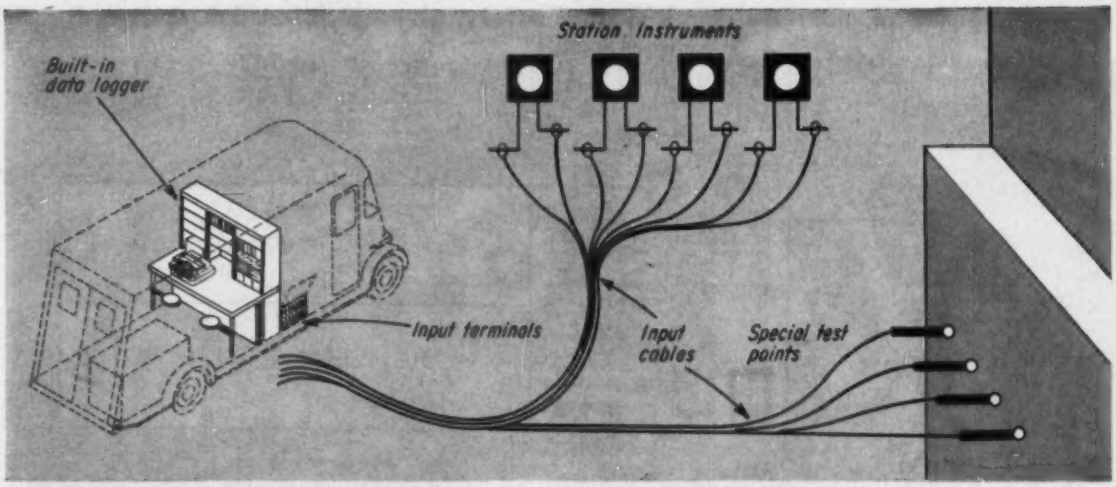
Plant engineers realize that true economy of instrumentation entails an absolute minimum of indicated operating data on the control panel. To put this principle into action requires a new viewpoint concerning what operating data *is* needed. Much panel data indicated today helps analyze operation malfunctions. Important when a malfunction occurs, it is not needed for normal operation and could be logged at the data-display station, easily available in an emergency.

Safety monitoring through the plant monitor is a key design difference between data loggers at left and monitors above. Integrated safety circuitry permits some cost savings over separate logger and safety equipment and permits warning, identification, indication and corrective action handled through one compact unit.

Several plant engineers have called for annunciators for instant identification of faults coupled with digital readout at the control panel. For some system faults, safety trip or runback control must be available at all times; to handle this requirement, critical readings are continuously monitored by parallel circuits. For other safety-monitor data, high-speed scanning is adequate; since various frequencies of required monitoring will appear for different data points, scanning sequence has to be flexible enough to check one point every second, another every minute.

Independent logging of operating data and safety alarms is demanded by many operating engineers. Although this requirement can produce complicated memory circuits, trend appears to be in the direction of uninterrupted logging for both alarm and normal data points.

Portable data-logging equipment goes into operation for several companies as interest in plant per-



TRUCK-MOUNTED LOGGER includes scanning system and data printout unit. Information from plant instruments and test-point elements passes through special cables. All special instruments store within the truck for shipment; small test crew handles job

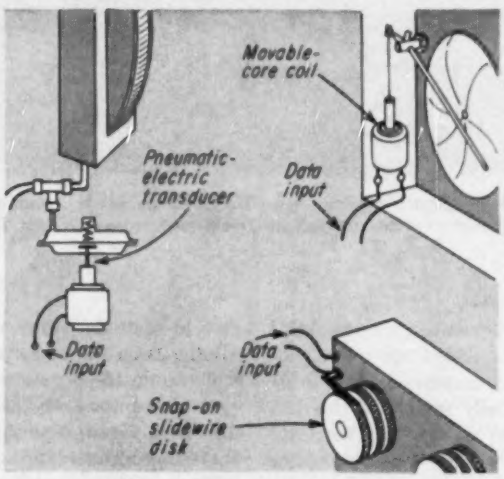
Portable units handle special plant test programs

formance reaches new highs. Portable loggers are not designed to take the place of permanent data systems, but rather to supplement them in the field of precise measurements for testing.

At least part of the justification for portable data systems lies in a lack of trained test personnel. Guarantee or performance test operations for an expanding utility may require trained test crews of 15 to 20 men. Preparation of data for calculation by computer consumes considerable man-hours. Right now trained test men are scarce, and all indications point to an even greater shortage in future.

To get around this difficulty, portable test systems are being constructed to be operated by two or three men. Current plans do not include the so-called suitcase logger but tend toward the truck-mounted system. Since value of a portable unit is tied up with *precise* performance testing, added flexibility and dependability of permanently mounted, large-sized systems is a must.

Present trend in portable systems is shown above. Main portion of data logger is permanently mounted within the truck body. Because of wide variations in testing requirements, data-scanning sequence is programed at the test site. In addition, linearization and calibration data for each point may be programed into predigitizing circuit. Date logged usually appears as printed records plus a punch-coded computer input which can be card or tape, depending on computer requirements.

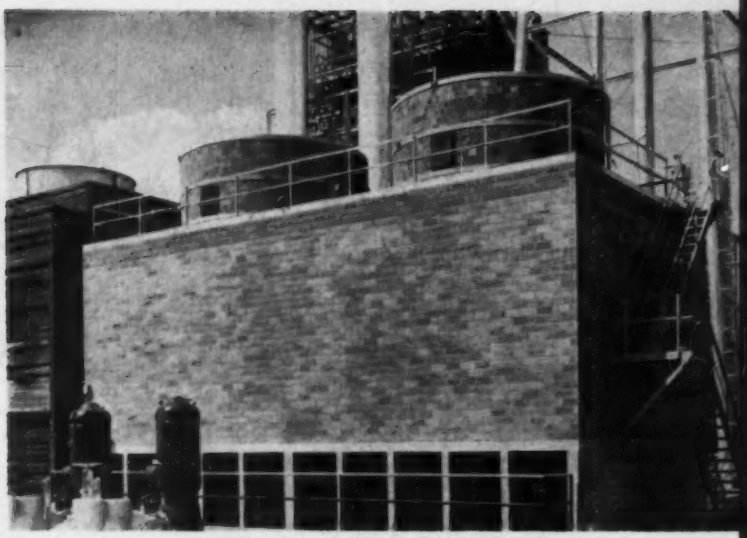


SIGNAL TRANSMITTERS relay test information from plant instruments. Transmitter matches the instrument's output

Data inputs enter the truck through plug terminals, using special cable sections. Scanned data includes readings from station instruments as well as special test points. Pickup of station data depends on type of data and form in which it exists within the plant. For pneumatic-control and transmitting systems, data may be picked up by special pneumatic-to-electric transducers or telemetering coils mounted at final mechanical output. Most electric signals merely require modification to match data-input needs. Standard hardware is already available and operating in plant-mounted data systems.

Future use of portable data systems may extend beyond utilities and heavy-equipment manufacturers who already operate several systems. By applying portable test units to many spread-out industrial energy systems, automatic data logging may bring its advantages to equipment too small to justify cost of its own personal performance-data logger.

Unique in that it uses no wood and is first of its type to be installed at a large central station, this . . .



MECHANICAL COMPONENTS equipping this ceramic cooling tower are no different from those installed with a conventional unit

Masonry cooling tower offers long life

Something a little different in the cooling-tower line went into service recently at a large central station in the Southwest: Constructed entirely of masonry, the 3800-gpm unit is being used for lube-oil-cooling water and other station auxiliary requirements. Utility gets its main condensing-water supply from a nearby lake.

The ceramic, 2-cell tower was manufactured and sold by the Ceramic Cooling Tower Co, a division of Acme Brick Co in Fort Worth, Texas. While the firm has been building this type of tower for some eleven years, this unit is the first to be installed by a major utility company in a power-generating station. Consulting engineers were Ebasco Services Inc of New York, N. Y.

Comparison of installed original cost of this all-masonry tower with a conventional redwood structure shows an initial investment, as might be expected, somewhere between 25 and 50% higher for the ceramic unit. However, considering the promised overall longer life of the structure itself plus probable lower operating costs and a considerable reduction in maintenance expense, it appears that the added initial investment could be justified. Such a structure of masonry and concrete could be expected to last in the neighborhood of 50 years.

Total capacity of tower is 3800 gpm. Unit was designed for 112-F hot water, 92-F cold water, based on a 78-F-ambient wet-bulb temperature. From a mechanical-component standpoint there's little, if any, departure from a conventional counterflow cooling tower. Big difference is in the use of masonry construction.

Cooling-tower basin is a simple reinforced-concrete sump such as might be found under any conventional tower. Tower walls, however, are of 8-in. masonry tiles of the type used in commercial building. Tile is laid in Class-A cement mortar with the wall inside the tower cleaned of excess mortar as each course is laid.

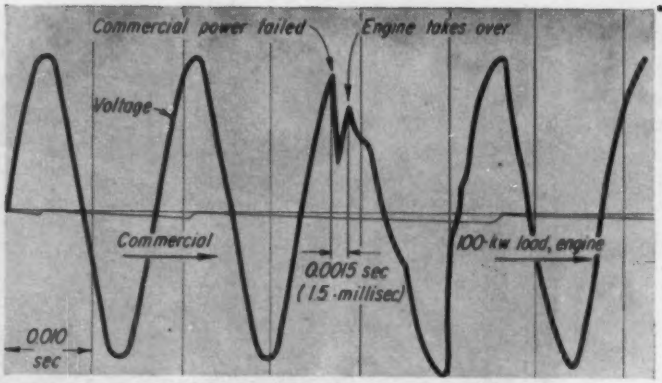
Near the top of the masonry walls a reinforced-concrete spider section provides support for the gear reducer and fan, along with the driving motor and roof slab. Latter, cast in pie-shaped sections which were hoisted into place, is 4-in. reinforced concrete and includes a fan venturi throat. Fan stacks are made of 4-in. tile reinforced by galvanized steel bands. Each stack has a cast-iron access door for maintenance personnel.

Construction completed, masonry walls were waterproofed by sheathing with polyester-resin fiberglass sheets 1/16-in. thick. Metal clips on approximately 2-ft 8-in. centers secure these sheets to the wall reinforcing. Special fiberglass shapes were used at both top and bottom of the walls to keep them completely dry.

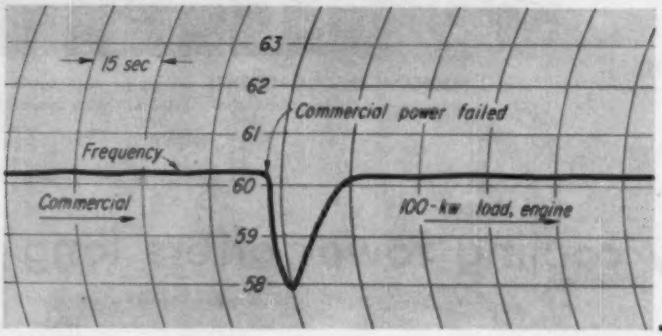
Water-distribution system is a low-pressure upspray type utilizing nonclogging brass nozzles. All internal piping is either of cast or malleable iron, except for the side arms—made of brass.

Tower's fill is acidproof vitrified clay tile to a height of about 4 ft 6 in. Stacked dry, tile's initial course rests on cast-iron lintels. Top course is packed tight to provide a walk space for nozzle inspection, cleaning, etc.

All air leaving the tower is pulled through a Z-shaped fiberglass eliminator section supported by fiberglass angles or tees. These, in turn, are supported from the roof deck or side walls by stainless-steel rods, in keeping with the unit's overall design for long service life.



Transfer critical loads from power lines . . .



to standby source with only slight disturbance, using . . .

Modern uninterrupted-power sets

By NORMAN PEACH, Associate Editor

Computer-controlled automatic generating stations and automated industrial processes are among the growing number of present-day electrical - energy - distribution systems which can't tolerate interruption of power for even a few cycles. Electronic instrumentation and control, telemetering and nuclear-plant auxiliaries all make severe demands on continuity of the energy-distribution system. Outside the power field, microwave communication, aircraft- and missile-guidance systems have similar exacting requirements. Several schemes to insure continuity have been devised: engine- or battery-powered units take over load so quickly on supply-line outage that the outage causes virtually no load disturbance.

Three basic schemes using rotating machines to supply uninterrupted power are shown at right. In the engine - motor - generator - set scheme, electric motor continuously drives the generator and flywheel. There is no electric-energy interchange between power-supply lines and load, the load being entirely supplied from the generator. If line power fails, motor is disconnected from the line and clutch is instantaneously energized to couple the engine to the flywheel. Inertia of flywheel carries the generator load and cranks the engine with only a slight decrease in speed. Engine comes up to speed in a fraction of a second and takes over supplying the load.

Second setup is similar, but only one rotating machine is used, serving as both motor and generator. A synchronous machine, it normally floats on the line in parallel with the load (and sometimes can be used as a synchronous condenser to improve power factor). Upon line failure the synchronous machine instantaneously changes to generator operation and delivers power to the load, driven by the flywheel. Simultaneously the clutch engages the engine which is brought up to speed and takes over job of supplying power to the load.

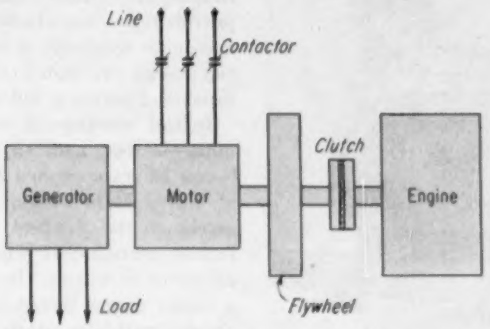
Third scheme has an ac machine, usually synchronous, running as a motor to drive a dc generator. Latter in turn keeps up charge on a battery connected to its terminals. If line power fails, the ac machine auto-

What is uninterrupted power supply?

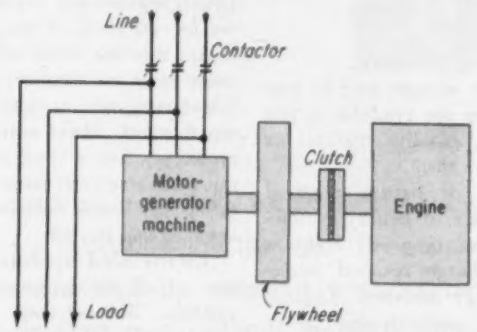
Conventional standby systems interrupt the flow of energy for a few seconds, at least, while transfer switches operate and engine starts up. For some kinds of service, however, an outage of a few cycles is too long. Curves, left, are for a 100-kw diesel-powered system using one synchronous machine as motor and generator. Note that power isn't interrupted during transfer, and distortion of voltage wave lasts for little more than one cycle of 60-cycle wave. Voltage is substantially restored to normal in 1.5 miliseconds.

Frequency dips two cycles, a fall of 3.5%, but recovers to original value in 15 seconds (seven sec for some sets). Such disturbances are tolerated by most present-day critical equipment. Voltage and field-current curves for battery-powered unit are on p 76.

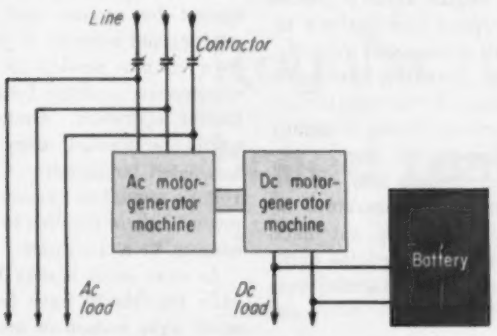
Engines or batteries supply energy



TWO-MACHINE scheme is normally driven by ac motor. When line fails, flywheel is coupled to engine for power



ONE-MACHINE arrangement is normally run on line; machine is motor. If line fails, machine becomes generator



BATTERY-POWERED set has coupled ac motor and dc generator which exchange their functions when line power fails

matically functions as a generator to maintain the load while the dc machine becomes a motor supplied by battery energy. Several variations on these three schemes have been designed by different manufacturers.

A fourth scheme for uninterrupted power uses a static electronic unit instead of rotating machines. Essentially a square-wave generator, it is normally supplied by an ac line but has a battery to take over when line is disconnected. Conventional engine-generator sets can be used for backup if outages are too long for battery capacity. Alternatively, unit can be fed continuously from a battery supplied from line through a battery charger. This system involves minimum disturbance on transfer. Where power requirements are small (one kva) and a square wave usable, static units have advantages in size, efficiency, low maintenance and lower initial cost of the standby set.

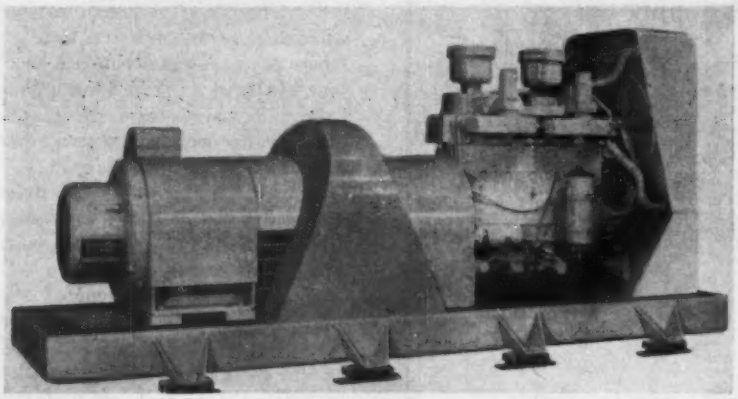
Requirements which an uninterrupted-power standby unit may have to meet: (1) continuity, with limits on transfer disturbance (2) voltage stability (3) frequency stability (4) energy capacity for duration of outage (5) reliability of standby energy source (6) unattended operation (7) ease of initial startup (8) infrequent maintenance. Each application has conditions which determine its own tolerances in any of these performance requirements.

Continuity of energy flow is maintained by all the systems, but extent of disturbance differs and must be specified. System illustrated by curves, left page, guarantees that voltage will not drop below 70% of normal rms during transition, and will be fully restored in 1.5 milliseconds. Frequency will not fall below 3.5% of normal and will be restored in seven seconds with most sets.

Battery-powered sets have the least disturbance in wave form since mechanical inertia isn't involved in transition. There is inevitably some falling off in speed of flywheel sets. On the other hand, duration of battery-supplied power depends on size of battery. Large batteries are expensive compared with engines and fuel reserve. Where large batteries are generally available, as in utility power plants, the economic balance shifts because uninterrupted-power units can take place of chargers.

Voltage stability is primarily a function of the voltage regulator, though a flywheel may damp out some fluctuations. Continuous voltage regulation can be obtained from the 2-machine flywheel scheme since there never is a connection between load and line. The other schemes can be set up to transfer to standby source when power-line voltage differs from specified tolerance. The 2-machine flywheel sets are built with either synchronous or squirrel-cage motors: with synchronous motor, output frequency will follow line frequency; with squirrel-cage motor, output frequency will vary according to motor slip.

continued



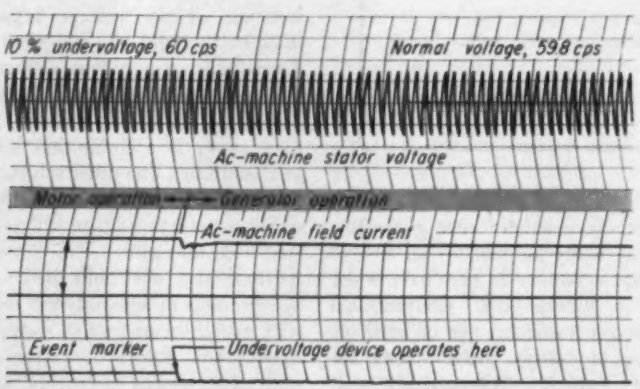
DIESEL ENGINE drives this 100-kw set when line power fails. Unit contains one synchronous machine, voltage regulator, flywheel and automatically operated clutch for engine

All schemes can be designed to shift to standby source when line frequency is outside tolerable band. Uninterrupted-power units are used for frequency stabilization in remote geographic locations where power company's frequency isn't dependable.

Engine-driven units are usually supplied with a time-delay device which prevents reconnection to the line for 10 or 15 minutes after normal line conditions are restored. This avoids repeated starting and stopping during periods of line instability, and also insures that the engine has an opportunity to get warmed up every time it starts.

Energy capacity of uninterrupted-power systems should be determined by probable duration of outages. For practical purposes, only limitation on energy capacity of engine sets is fuel supply, which makes them desirable for isolated unattended locations where outages may be prolonged. Engines are available to run on diesel fuel, gasoline, natural or liquid petroleum gas.

Reliability of battery-powered units is a matter of battery maintenance. Batteries in good condition and proper charge respond immediately to energy demands. Engines designed for uninterrupted-power units have features to insure startup. Flywheel is an effective means of cranking the engine since it rotates at operating speed and engine's inertia is small compared with flywheel's. High cranking speed improves ignition. A thermostatically controlled crankcase heater is usually provided and warm oil may be circulated. Water heaters may also be installed if ambient temperature indicates their need. An automatic program timer can start engine every seven or ten days for warmup run.



OSCILLOGRAM for battery-powered set shows negligible disturbance of voltage and frequency during transition to batteries because of 10% undervoltage on ac power line

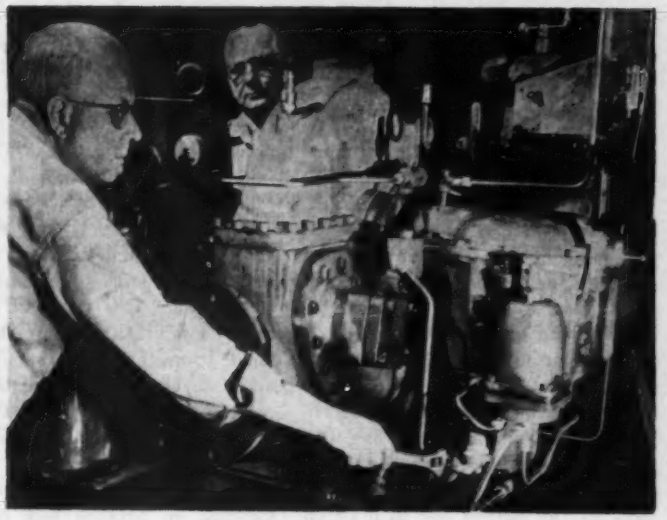
Remote monitoring of uninterrupted-power units usually can be provided by manufacturer. Where maximum reliability is justified, you can operate two units in parallel, each capable of carrying full load.

Initial startup of engine-driven units—starting with all parts at rest—can be accomplished in a number of ways. Main consideration is to accelerate the flywheel, which then rotates continuously whether driven by motor or engine. In one method a starter motor, like those used with conventional sets, starts up the engine. Clutch is automatically jogged until flywheel runs up to speed. Clutch engages and engine drives the set for duration of the preset time delay; then the motor takes over. In some cases an auxiliary high-torque low-starting-current motor accelerates the flywheel. Hand cranking uses a crank jaw on a shaft extension on the generator end: with flywheel rotating sufficiently fast, engine can be engaged and started.

Unattended operation is a feature of all the uninterrupted-power systems. Telemetering and microwave stations may not be visited for months, and units *must* function without inspection. Maintenance required by motors and generators, engines and batteries is probably less than usually needed to keep these components in shape because of controlled operation. Units can ordinarily be located away from contaminated atmosphere. Controls and voltage regulators employ static components where possible to keep maintenance to a minimum.

In some cases it may be economically feasible to have two or more small units instead of one large one. Then any machine may be removed for maintenance without impairing uninterrupted power to the entire load. One leading manufacturer of battery-powered units recommends this to utility power plants for control-bus power. In such an application, reliability justifies extra cost.

Power ratings of units range up to 200 kw for engine sets and 40 kw for battery units, ac output. Control equipment is mounted in compact cubicle, and generally contains ammeter, voltmeter, frequency meter, indicating lights, test buttons, in addition to control components required for automatic operation.



This last part of the m-d turbine series shows how planned maintenance programs lay the basis for economical operation. Gains are realized by catching troubles before they have a chance to start and perhaps cause a production shutdown

Regular turbine inspections breed real dollar savings

By R A BRIDGMAN, Manager, Factory and Field Engineering
Small Steam Turbine Dept, General Electric Company

Let's talk about areas of mechanical-drive turbines where planned maintenance programs yield the greatest returns. These gains come in the form of minimum downtime and maximum production.

Turbine's rotor is the largest and heaviest part of the entire unit. While not the sole cause of turbine-vibration troubles, it plays a big part in keeping them under control.

Maximum turbine-shaft vibration amplitude permissible under current manufacturing tolerances is 0.002 in. within specified operating-speed range of a unit. Outside that range, amplitude may rise to 0.003 in. Within the operating range, vibration amplitude on bearing caps should be held to 0.001 in. or less.

Shaft vibration amplitudes on older machines that have seen considerable service can usually be allowed to run as high as 0.003 in. But over that limit they lead to excessive wear on bearings, packings, valve gear, governor linkages and flexible couplings. Severe cases may crack and break turbine's oil piping.

Turbines that have run a long time sometimes vibrate excessively because of unbalance, shaft rubbing, worn flexible couplings, worn bearings and improper bearing-oil pressure or temperature.

Taking periodic shaft-vibration amplitude readings (see Part 7, POWER, July 1959, pp 71-73) proves to be the best way of anticipating excessive vibration and damage. Vibration usually does not increase suddenly or in a short time, so read-

Coddling turbine rotor lengthens the life of the unit

ings don't need to be taken often, but should be taken at regular intervals; once a week or not less than once a month may prove practical.

These readings should be logged and plotted. That way, any gradual vibration increase will be noted and preventive-maintenance steps can be planned and executed as needed.

Unbalance of a rotor may be caused by: (1) change in mass distribution from bending owing to uneven heating during starting (2) an uneven buildup of deposits on the rotor, from an excessive boiler carryover (3) an uneven loss of material from rotor, caused by corrosion and erosion or damage by foreign material and slugs of water passing through the turbine.

Rotor bending caused by uneven heating results from admitting steam to the turbine casing while rotor is stationary. Leaky inlet or exhaust valves cause bending during shutdown. Turning on the gland-sealing steam while rotor is stationary bends it during startups.

High - vacuum machines using gland-sealing steam should be rolled over immediately after admitting live steam to the packing boxes. Starting a unit that has not been shut down long enough to cool to a uniform temperature often causes vibration because of the heat bow.

When you suspect that a heat bow causes vibration, slow the turbine to a speed where vibration is tolerable. Keep it there until it heats uniformly and then bring up to operating speed. Failing to do this may bow the rotor permanently and unbalance it, making the shaft rub on diaphragm packings and cause localized heating at these points.

Boiler carryover usually deposits uniformly on a turbine rotor and so may not cause an appreciable unbalance while rotor runs. But these deposits may be partly washed off when turbine shuts down, or sections of the deposit may fall off. When restarted the unit may be seriously unbalanced.

Deposit troubles are best treated by eliminating the condition that carries them into the turbine. If this cannot be done, washing may remove water-soluble deposits. Turbine builder will specify the safe way of removing deposits by washing.

Loss of material from the rotor causes unbalance that can be corrected by repairing the damage, or rebalancing. This can best be done in a shop fitted with proper equipment. Sometimes, for small unbalances, turbine may be rebalanced in place by inserting weights in the balancing holes provided on most turbine shafts.

Vibrations caused by turbine shaft rubbing on packing and deflectors usually happen only after diaphragms, packings, etc have been newly installed. Rubs on metallic packings can usually be eliminated by running the turbine at low speed, then gradually increasing speed until the rub disappears. Rubs in carbon packing on the shaft will require shutting down the turbine to reexamine the packing for clearance, jammed springs and excessive sealing compound inside packing box.

Worn flexible couplings can cause excessive vibration since the worn teeth allow coupling sleeve's center of mass to run eccentric with respect to rotation center of the shaft. Worn couplings should be replaced —they cannot be repaired because sleeve has no consistent location in respect to rotation center.

Badly worn journal bearings cause excessive rotor vibrations. Increased clearance in a worn bearing cannot maintain a stable oil film. Periodic bearing inspection will uncover need for replacement before troubles start.

Letting oil pressure run out of its operating range or letting incoming-oil temperature rise too high may cause excessive rotor vibration. Generally, oil pressures should run about 10 psig and inlet temperatures between 110 and 120 F. But be sure to follow the manufacturer's specific instructions.

Radial bearings. Modern high-speed shafts need higher bearing loading to maintain oil-film stability and eliminate oil whip. This results in thinner oil films between journal and bearing. Just a small amount of dirt of the smallest particle size scores babbitt and grinds away journals because of thinner oil films and increased tendency of particles to imbed in the babbit at high journal speeds.

This means that greater oil cleanliness must be maintained than ever before. In difficult environments, good filters should be permanently installed in the lube-oil system, or alternatively use good filters as part of a portable filtering system that can be attached to the turbine oil system while unit runs.

The best checking method on bearing performance regularly observes and records outlet-oil temperatures from the bearing. Any marked or sudden change signals that bearing condition warrants investigation.

Maximum temperatures within the oil film in a running bearing and just below the babbitt surface are considerably higher than those measured in the oil stream leaving the bearing. Temperature difference of these two locations depends on the relatively large part of the oil that passes quickly through the bearing at points of maximum clearance and does not heat appreciably. The much hotter oil from loaded areas of the bearing mixes with the predominant cooler oil, giving a relatively low exit temperature. Maximum outlet temperature of 170 F is a good criterion of bearing performance.

Turbine instruction books usually allow slightly higher clearances than original "as-manufactured" clearance before recommending replacement. Check these instructions when making bearing inspections to determine need of replacement.

In pressure-pad type bearings, carefully inspect the pad in the upper half to make sure the pressure-pad cavity has sharp ends. A worn end tends to decrease loading effect of the dynamic pressure resultant generated by the rotating journal, and shaft may develop a tendency toward oil whipping. A worn bearing should be replaced.

Thrust bearings keep the rotor properly located in the turbine casing and absorb the forces created by

steam flowing through the turbine. But thrust bearings must do additional duties by absorbing or counterbalancing variable thrusts caused by: (1) turbine deposits (2) damaged steam-path parts (3) misalignment of flexible-coupling teeth and (4) increased coefficient of friction of worn teeth.

It is impractical to design a thrust bearing large enough to absorb all possible extra thrust from these external factors. Space limitations within the bearing bracket and excessive heat loss in the oil film of such a large bearing prevent an economical design. We emphasize this added thrust to point up areas where preventive maintenance can go a long way toward ensuring satisfactory thrust-bearing life.

Oil outlet temperatures at outer periphery of a thrust bearing tend to run higher than outlet temperatures for a radial bearing. A lower percentage of cooler "bypass" oil flows through a thrust bearing than through a radial bearing.

When inspecting thrust bearings during routine maintenance, measure their thickness with micrometers. Comparing this with allowable minimum listed in the instruction book will show whether you can let them ride or they should be replaced.

In tapered-land type thrust bearings the taper builds up an oil wedge that develops greater load-carrying capacity. Make sure to check thickness of these bearings with micrometers during inspection—the tapers run from 0.002 to 0.003 in. in depth. Worn tapers have much lower load-carrying capacity.

Shaft packings reduce steam leaking out of the casing to a practical minimum, also reduce leakage between stages in a multistage unit. Packings use two basic materials, carbon and leaded bronze. Packing rings are designed for minimum practical shaft clearance at operating temperatures. Steam leaking through interstage packing reduces internal efficiency because it does not work on the buckets.

Steam leaking through end packings in a turbine casing causes a loss of heat energy. It also greatly increases corrosion of vital turbine parts, such as valve gear and linkages. Excessive moisture accumulates in the oil system because of proximity of bearing brackets and packing boxes.

Excessive leakage through packings can be caused by too much packing-ring wear, improper piping of drain connections from packing boxes, steam deposits and excessive sealing compound in the packing boxes, and improper installation of individual rings. Packing rings seal on one side only—the sealing side should be in the direction of pressure drop through packing box.

Packing-box-drain piping usually is more of an installation than a maintenance problem. But for persistent packing leakage check the piping connections against the outline instructions to spot trouble source. Running a turbine with excessive vibration amplitude is most-common cause of excessively worn packings.

Governing. Modern high-speed turbines are designed for accurate and responsive governing. Components of governing systems must be precisely finished and have close fit and low friction.

Hydraulic oil flowing over these parts must be kept as clean as possible. In a governor (see Part 5, POWER, May 1959, pp 68-70), pilot-valve bushing and pilot valve itself must fit together closely and yet not bind. Upper edge of the pilot valve, which controls oil flow to the primary operating cylinder, must be kept clean and sharp with no rounding of the edges. External pivots and pin joints must be kept clean and lubricated to assure lowest possible friction.

Proper level of hydraulic-oil pressure must be maintained always to assure accurate governing. All adjustable governing linkages should be maintained strictly in accord with the instruction book for the unit.

Safety devices. Trip settings of the emergency overspeed governors are locked by staking. These should not be changed or adjusted in any way unless a routine overspeed-trip check shows more than ± 2% deviation from specified setting. Needed adjustments should be made only with a qualified field representative of the turbine builder present.

Low-oil-pressure type, remote solenoid-operated tripping devices and similar equipment should be kept in top shape all the time and tested as shown in the instruction book.

Inlet steam strainers, usually in the throttle-valve body, should be inspected after the first few days of initial operation of a new turbine. After that, inspect them quarterly or as often as operating schedule will allow. These inspections will permit removing excessive deposits or foreign material which, if lodged against the strainer, can seriously reduce area for steam passage.

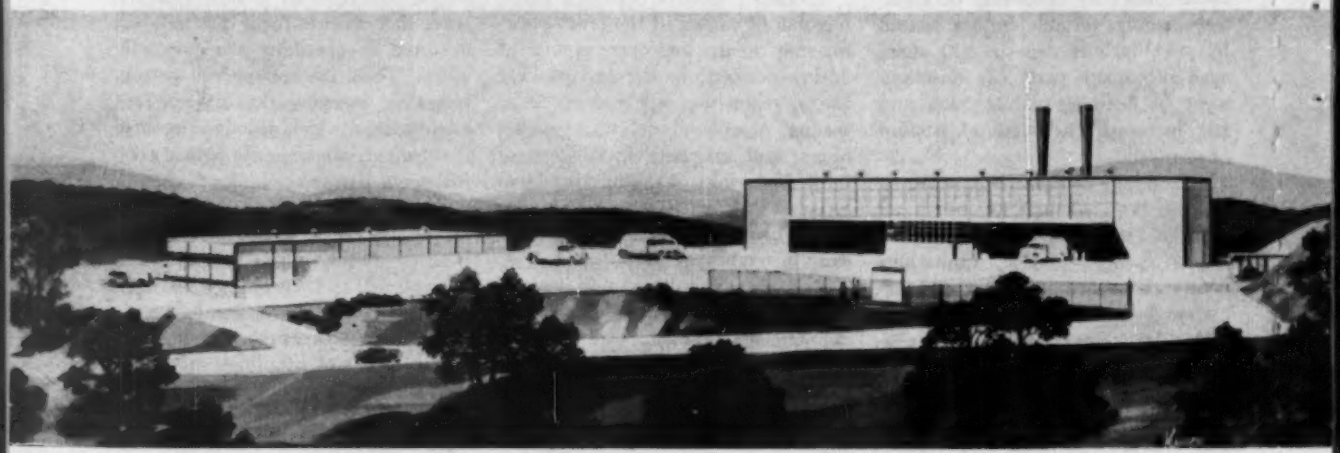
Breaks or damage to the strainer should be repaired immediately, or if necessary the entire strainer should be replaced, to keep foreign material out of the smaller steam passages.

Flexible couplings. Driving and driven halves of couplings should be aligned with each other as closely as possible at operating temperature of the turbine and load. Alignment can be closely approximated in cold condition by allowing for estimated shaft rise of turbine and load. Actual amounts of shaft rise, however, vary from machine to machine owing to differences in ambient temperature, degree of lagging coverage, and steam-temperature variation. At best, initial cold alignment is an educated guess.

Best practice heats up both driver and driven unit by running a short time and then shutting down quickly. A careful alignment check with dial indicators measures actual alignment accuracy. An unsatisfactory alignment can usually be corrected with only one more adjustment. Accurate alignment must be maintained to assure long and successful coupling life.

Flexible couplings can run with rather severe misalignments when new—but the greater the misalignment, the shorter the life of the coupling. A flexible coupling with misalignment not over 0.002 in. could be expected to last indefinitely and give successful service. On the other hand, with a misalignment of, say, 0.030 in., a coupling would probably not last longer than six months or so. It would probably fail from excessively worn teeth.

Most modern high-speed couplings are dynamically balanced in the process of manufacturing. The mating parts, bolts and bolt holes are usually stamped with identifying numbers or marks. Whenever dismantling a coupling for inspection or regreasing, take care to line up all parts with their original match marks during reassembly. THE END



MODERN INCINERATING PLANT has pleasing structural design, is equipped with dust collector which eliminates need for tall stacks

Increased incinerator use for industrial and municipal waste disposal plus rising fuel and power costs warrants a close look at how to utilize . . .

Available heat

Increasing use of incinerators for industrial and municipal waste disposal, combined with increasingly high fuel and power costs, poses a dual question: (1) how much heat is available from such a furnace? and (2) how can it be utilized economically?

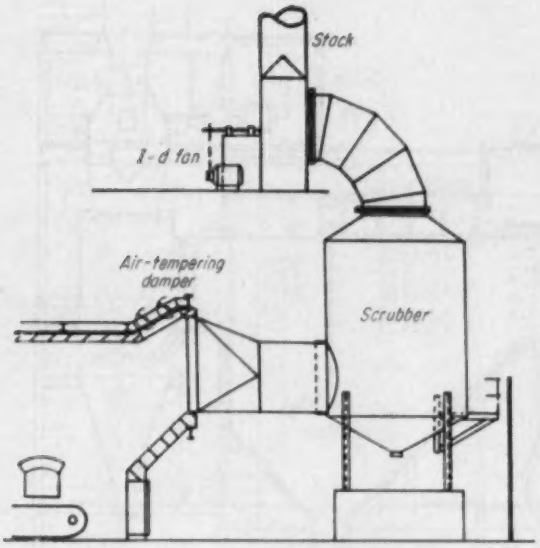
Incinerator heat output is easier to calculate when characteristics of material to be burned are known. In municipal refuse, for example, percentage of high-moisture garbage has declined in many areas due to advent of prepared, frozen, canned and otherwise packaged foods plus use of garbage-disposal units in homes and restaurants. Today's rubbish is largely paper bags, cartons and similar dry combustible material. This is much bulkier, but more easily burned if—and this is a big *if*—furnace design is adequate.

Industrial refuse characteristics, too, have changed radically in the past decade owing to greatly increased output of plastics and other synthetics. Many of these have much higher Btu content with little moisture or ash. They're being offered in increasing amounts for disposal by incineration, partly because tighter air-pollution laws prohibit former open-dump burning methods, and partly to reduce hauling costs.

Highly variable in appearance, much combustible refuse is nevertheless closely akin to wood and similar cellulose raw materials from which it derives. Analyses of test samples show that heat of combustion (on a moisture- and ash-free basis) closely parallels that of cellulose, about 8000 Btu per lb. This simplifies heat-process calculations, makes it possible to predict material's behavior when burned. Most important variable is moisture, the incinerator's energy-consuming load.

To determine heat available from refuse, we must first select a unit heat value from tables or by calorimeter tests. This unit heat value is then converted into total heat produced in the furnace. Preferably expressed as so many million Btu, it's simply the product of fuel burned in lb per hr and unit heating value, as fired. Example: Assume a typical municipal refuse, 8000 Btu per lb moisture and ash free, with 25% moisture and 12.5% ash or other noncombustibles—cans, bottles, tramp iron. As-fired heat value is then $8000 \times (1 - .375)$, or 5000 Btu per lb. For a 100-ton-per-day (24 hr) rated-capacity incinerator, we first convert this to 8340 lb per hr, which we multiply by 5000 to arrive at a total of 41.7 million Btu per hr.

Average incinerator has an all-refractory furnace, with no water cooling, so we must determine what temperatures will develop and keep them to safe limits to avoid excessive slagging and maintenance. Since we can't always control moisture, furnace temperature must be limited by excess-air-supply adjustments. Existing calculations, available as charts, show that for a 25%-moisture refuse we'll need 100% excess air, while for a 50%-



GAS-SCRUBBER installation is another result of tighter air-pollution laws. I-d fan is a must owing to low temperature of exit gas

By H G MEISSNER, PE

from incineration

moisture fuel, excess air should be reduced to about 45%. For 25% moisture our total air needs are 12,300 cfm, and gas leaves the furnace at about 2000 F.

When gas passes *directly to the stack* through combustion, expansion or settling chambers, these chambers, as well as the stack, must be designed to handle gas temperatures of 2000 F or more because there's little cooling, except for radiation and air leakage, between furnace and stack. Stack for such an installation usually must be of double-lined refractory construction, between 150- and 200-ft high. Draft is usually excessive for furnace requirements. Water-cooled dampers are sometimes used, though a barometric damper may be preferable—it costs less and is easier to maintain since it's outside the high-temperature zone.

Stricter air-pollution ordinances may eventually lead to abolishing the conventional expansion and settling chambers in favor of mechanical dust collectors or scrubbers. I-d fans and short stacks will replace the large brick chimneys which are now the symbol of the municipal incinerator—artist's drawing, at left, indicates neat appearance of this modern design.

Such mechanical equipment functions best under reasonably steady temperature and volume conditions. The well-designed plant, then, should control primary combustion and subsequent gas-cooling medium so that maximum collection efficiency is assured at all times.

With the wet scrubber, this is done by sprays at right angles to the gas stream as gas enters scrubber throat. Gas is further cooled and washed free of most of its entrained dust by sprays and baffles, bringing temperature down to about 150 F as gas leaves the scrubber. Since this is much too low for natural draft, the i-d fan is a must. Stack for this flyash-removal system only needs to be high enough to let fumes and vapor clear adjacent buildings.

Water requirement for a wet scrubber is approximately two gpm per million Btu burned. About two-thirds of this may be reclaimed in dewatering tanks and recirculated. Solid deposits are removed by clamshell bucket or similar means. Typical unit is shown at left.

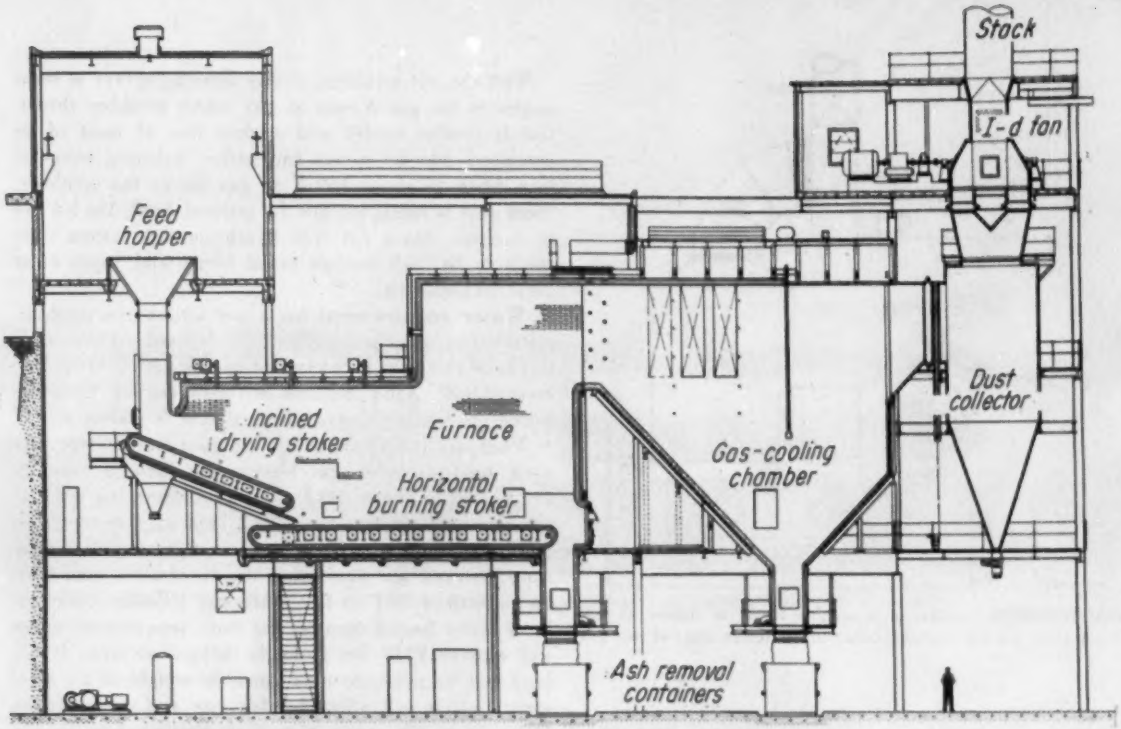
When dry collectors, multicyclone or similar type, are used, hot dust-laden gas leaving the furnace must be first cooled to about 700 F to prevent damaging the dust collector and i-d fan assembly. This may be done by admitting air, water or both to the hot-gas stream. Quantities involved are significant: one lb of air heated from an ambient of 80 F to 700 F absorbs 150 Btu, while one lb of water heated through the same temperature range will remove 1340 Btu from the hot-gas stream. It follows that we must use nine times the weight of air as of water, which will affect i-d fan size and power input. Drawing, p 82, shows a typical dry-collector installation. Fog-nozzle sprays should be used, rather than jet type, since all water must be converted to dry superheated steam to avoid condensation and dust-collector-element fouling. Fog nozzles also minimize water consumption.

Utilizing heat. Heat output from a modern continuous-feed furnace is so much more uniform than that from conventional batch-feed types that utilizing this heat may prove profitable in many cases. Let's take a closer look at the heat energy available, then consider possible ways of putting it to work instead of letting it escape.

Heat value of common refuse material may vary widely, depending on whether it comes from municipal or industrial sources. Refuse may also vary in Btu from day to day. Differing appearance apparently has confused some observers in the past and they've been content to blame changes in heat output or furnace conditions on the fuel, rather than working to improve the furnace or firing methods to get more uniform output.

With batch-fed furnaces it's obviously impossible to prevent heat-output variations. Furnace is alternately stuffed and starved, reminiscent of the old hand-fired coal-burning days. But with modern continuous-feed stokers installed in well-designed furnaces, and with up-to-date instrumentation and controls, these variations largely disappear. For example, with the popular bin-and-crane storage and handling system for refuse, crane operator mixes wet and dry materials as they're dumped from trucks. Thus the effect of a rainy day or a big load of high-moisture material is less noticeable. Trend toward covered containers and trucks also has had a beneficial effect since, as we've noted, moisture content is by far the principal factor in determining as-fired heating value.

Utilizing heat from an incinerator is generally practical only when it can be done nearby, and as available, unless an auxiliary fuel such as gas or oil is used. Most incinerators operate from eight to 24 hr per day and five or six days per week. Collections are seldom made



DRY DUST COLLECTION requires that furnace gases be cooled to about 700 F to prevent damage to collection equipment and i-d fan assembly. Cooling medium is usually air, water or both. Pound for pound, however, water is nine times as effective as air

Steam generation for sale can be attractive

over the weekend and storage is usually impractical—refuse is bulky, averaging 300 to 350 lb per cu yd.

Low-pressure heating boiler for hot water and space heating in winter takes only a small portion of the hot gas. This is generally bypassed from furnace to boiler and back to stack. Boiler can stay in service for hot water during the summer because the equipment requires little attention other than checking controls.

Boiler equipment for high-pressure-steam generation to be sold to a commercial user is generally a higher-pressure design, requires licensed operators when it's in service. Labor cost, amortization and maintenance must be considered in setting steam-charge rates. In general, steam output must be at a relatively high and steady rate to be attractive, and steam lines must be short to avoid undue losses.

Same considerations apply when power generation for sale is planned. In this case, however, first cost and operating expenses will be proportionately higher, and need for continuous, reliable service even greater.

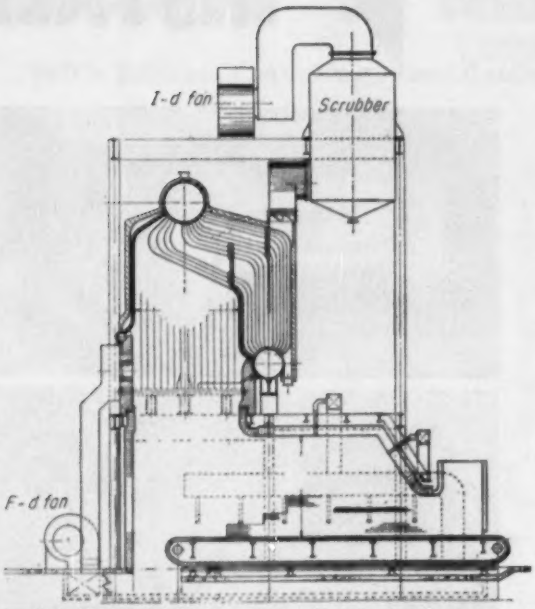
Power generation for the incinerator plant itself meets proximity requirements and has been applied successfully in a few cases. Steam can be used in back-pressure turbines so that heat and hot-water needs are met and the power output supplies all motors for fans, pumps, stoker drives. Provision may be made for supplying power or steam to adjacent municipal buildings, for pumping water to storage tanks or for related needs. With oil burners in reserve to fire the boilers, and a diesel-generator set for startup and emergency, such a setup becomes quite practical and economical.

With an industrial-plant incinerator, steam or power generation becomes more practical. Frequently the setup can be located next to the existing power plant and feed steam into the plant headers. Regular operators can take care of the additional unit with a minimum of cost, except for refuse handling and storage facilities. Here's an actual example of this scheme:

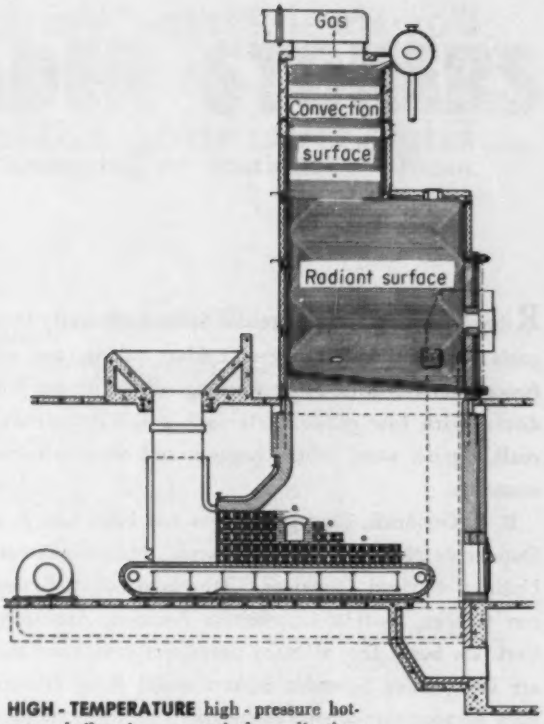
Waste material was made up of a number of liquid and solid combustibles from rubber-goods manufacture and a large chemical plant, plus a considerable amount of normal refuse—garbage, rubbish, paper and wood products. There was also the usual complement of cans, bottles, metal scrap. Heat value of the ingredients ranged from 8000 to 20,000 Btu per lb.

Total refuse averaged about 80 tons per day. Analyses on a weight basis revealed average heating value of about 10,000 Btu per lb. For proposed 24-hr operation, available heat output was calculated at 66.7-million Btu per hr. Auxiliary fuel oil was provided for in the furnace design. Incinerator and boiler will go up next to the present boiler plant, with a bin-and-crane system for handling and storage.

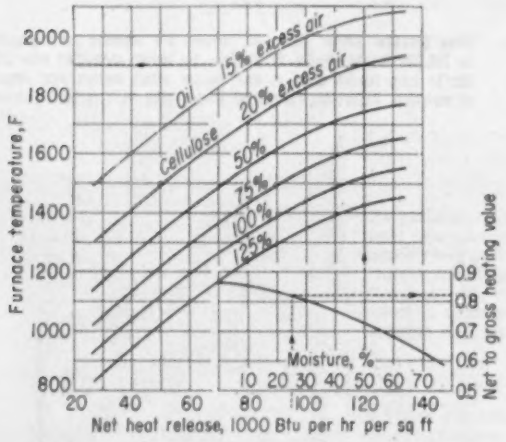
Overall boiler efficiency was estimated at 70%, and enthalpy of steam was 1100 Btu per lb, so boiler output was easily calculated as 42,500 lb per hr. Assuming 82%



STEAM GENERATION from boiler fired by incinerator can be economical, particularly if unit can be located near existing plant



HIGH-TEMPERATURE high-pressure hot-water boiler is a practical application



WATERWALL-FURNACE temperature curves are based on heat-pickup tests. Chart also shows gross-to-net conversion

efficiency when firing oil, each ton of refuse fired will replace 114 gal of fuel oil. Thus the 80 tons fired per day will save about 9120 gal of oil. Added savings include reduced cost of hauling to outside dump, to say nothing of the advantages of improved public relations. For a close approximation we can predict an evaporation rate of 3 to 3½ lb steam per lb municipal refuse, or 6000 to 7000 lb per ton. A somewhat higher evaporation rate may be possible with industrial wastes, depending on unit heating values.

Waterwalls in incinerator furnaces seem justified only when boiler is mounted above the furnace so that surface can be tied into the steam-generating cycle. Thus it becomes a major factor in boiler output as well as giving protection to the refractory.

Heat quantity picked up is readily calculated using formulas and transfer rates developed by boiler manufacturers. Black surface so installed is called "Effective Projected Radiant Surface" (EPRS); curves at left are based on tests with chemically similar fuels. Resultant furnace temperature is obtained by dividing total heat input from combustion of the refuse by EPRS in sq ft and using curve to read off furnace temperature. Chart also shows gross-to-net heating value conversion scale.

High-temperature high-pressure hot-water boilers, too, fit in well for using incinerator heat, provided secondary fuel is included to take care of periods when refuse isn't available. Drawing, above, shows typical application of an incinerator to fire a h-t hot-water boiler.

Combination refuse-incinerator and sewage-disposal plants seem to have increasing merit. Hot furnace gas can be used in the flash dryers and sludge may be returned for incineration when it isn't processed for fertilizer. Noxious gases may pass into furnace for dissociation of objectionable fumes before discharge to atmosphere, in many cases reducing required stack height.

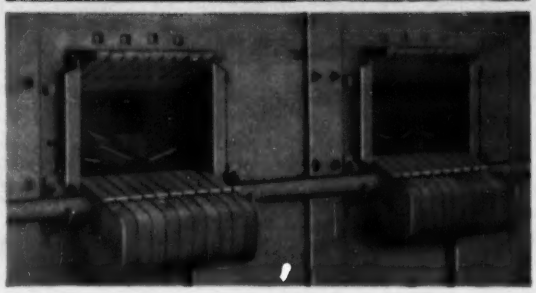
Dual disposal of mixed refuse and sewage sludge at the same plant site can produce economies both in first cost and operating expense. It enables small communities to provide modern disposal facilities, where added cost would rule out separate plants.

For Fuel Firing Versatility ...Low Cost Maintenance ...High Operating Efficiency

INSTALL

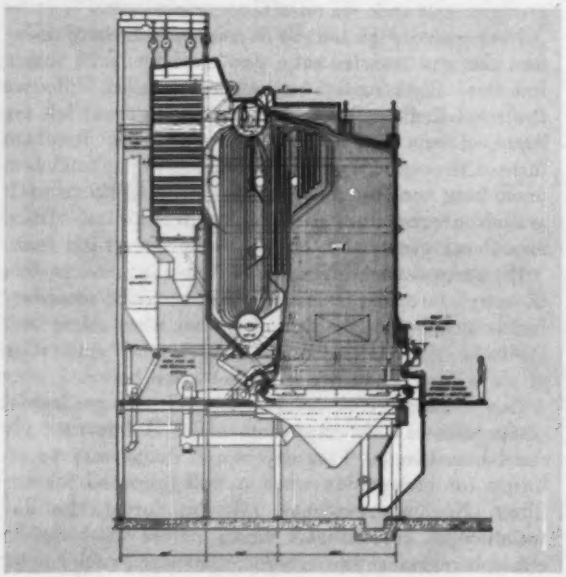
Riley Traveling Grate Spreader Stokers efficiently burn coals having a wide range of coking, caking, and ash fusion characteristics. High working efficiencies are produced with low grade fuels such a sub-bituminous coals, lignite, wood refuse, bagasse, and other cellulose materials.

B. F. Goodrich, Champion Paper and Fibre Co., E. I. Dupont de Nemours, General Electric, Montana-Dakota Utilities, Gaylord Container, Utah-Idaho Sugar, Kennecott Copper, Swift & Co., Bendix Aviation, Armstrong Cork are but a few of many prominent companies that are using Riley Spreader Stokers under Riley Boilers. Such performance-proven installations as these substantiate the superior operating characteristics of Riley Spreader Stokers: uniformity of feed and distribution . . . complete, continuous combustion . . . low carbon loss . . . high day-to-day overall efficiency . . . long-term, low-cost maintenance.



Two Feeder Models

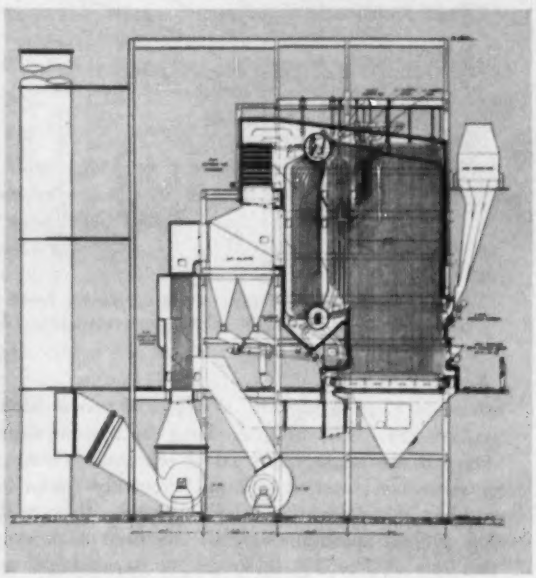
Riley Spreader Stoker Model 'B' Feeders are supplied for capacities up to 200,000 lbs/hr; Model 'D' Feeders for boiler capacities over 200,000 lbs/hr have feeder drum in coal hopper which meters coal regardless of moisture. Adjustable distributor blades give uniform coal distribution.



In Combination With Natural Gas Firing

Deere & Company, Moline, Ill.

Two 16' x 19' Riley Traveling Grate Stokers equipped with Riley Model "D" Feeders fire two complete Riley Steam Generating Units with pressurized furnaces. Riley Intertube Gas Burners fire natural gas as an auxiliary fuel. Capacity 135,000 lbs/hr, 750F, 650 psig. Efficiency 84.8%.



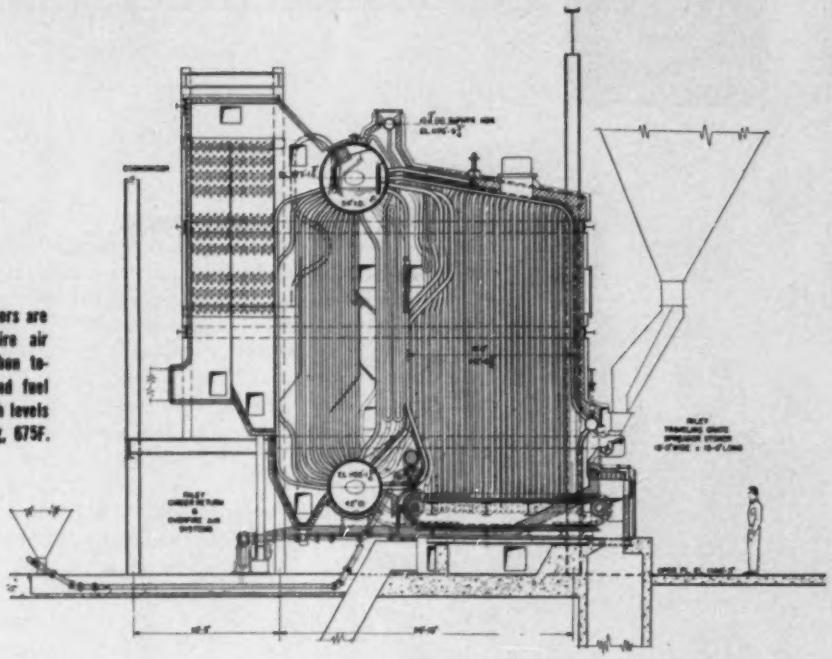
Simultaneous Bark and Coal Firing

Marathon Southern Corp., Naheola, Alabama

A 26' x 22' Riley Traveling Grate Spreader Stoker, fed by Riley Model 'D' heavy-duty Coal Feeders and Riley Pneumatic Bark Distributors, fires this 300,000 lb/hr Riley Steam Generating Unit with an efficiency of 85%. 875 psig, 825F.

RILEY SPREADER STOKERS

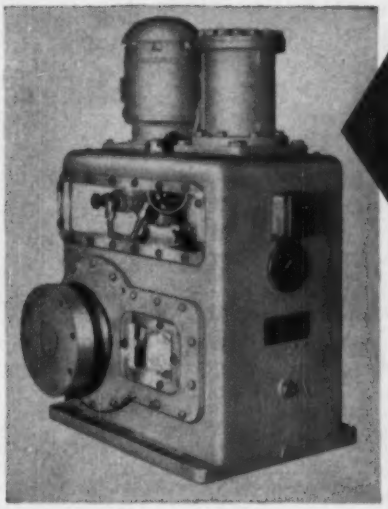
With Either Traveling, Oscillating, Dumping or Stationary Grates



Cinder Return And Overfire Air System

Pennsylvania Railroad, Juniata Shops, Altoona, Pa.

Many Riley Traveling Grate Spreader Stokers are equipped with cinder return and overfire air systems. High recovery of unburned carbon together with intimate blending of air and fuel assures a wide range of operation at high levels of efficiency, 3 — 60,000 lb/hr, 800 psig, 675F.



Smooth, Continuous Operating Hydraulic Drive for Traveling Grates

The self-lubricated Riley Hydraulic Traveling Grate Drive power unit operates quietly and smoothly with uninterrupted continuous automatic or manual speed control from stop to full load. The design does away with sprockets, chains or gears. A pressure gauge describes load conditions at all times.

High Efficiency Grate Surface

Providing high efficiency with low maintenance requirements, the surface of the Riley Traveling Grate Spreader Stoker has small (2" x 6") overlapping grate clips, of special heat-resisting alloy. Nose-over-tail design forces clips to separate when starting return travel, freeing themselves of ashes and clinkers. Tuyeres in the center and at sides of clips give uniform air distribution.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

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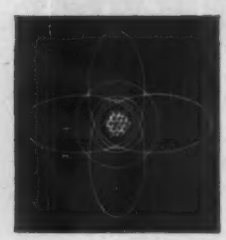


Nuclear notes

By B G A SKROTZKI, Associate Editor

PM-2A (portable, medium-power) reactor built by ALCO Products, Inc for the Eastern Ocean District, Army Engineers, has finished its shop tests and is now being shipped by vessel to Camp Century, Greenland, about 150 miles east of Thule. This arctic research camp will be supplied 1560 kwe and 1-million Btu per hr heating by the highly enriched UO_2-fueled reactor. The $3.2-million pressurized-water plant mounts into 27 transportable packages designed to be carried by military cargo aircraft. Heaviest package weighs 15 tons. Nuclear station will have standby plant of three 300-kw diesel engines. Year's supply of 15,500 drums, 55-gal, of diesel oil needed by conventional plant is displaced by nuclear fuel equaling about eleven 55-gal drums in volume; see p 65 for picture of reactor package.

Safety Code for Fissionable Materials ASA N6 has been proposed jointly by American Nuclear Society and American Society of Mechanical Engineers. Copies of this 4-p pamphlet can be obtained for criticism and comments by writing on your letterhead to G C Finster, American Society of Mechanical Engineers, 29 West 39th St, New York 18, N. Y.

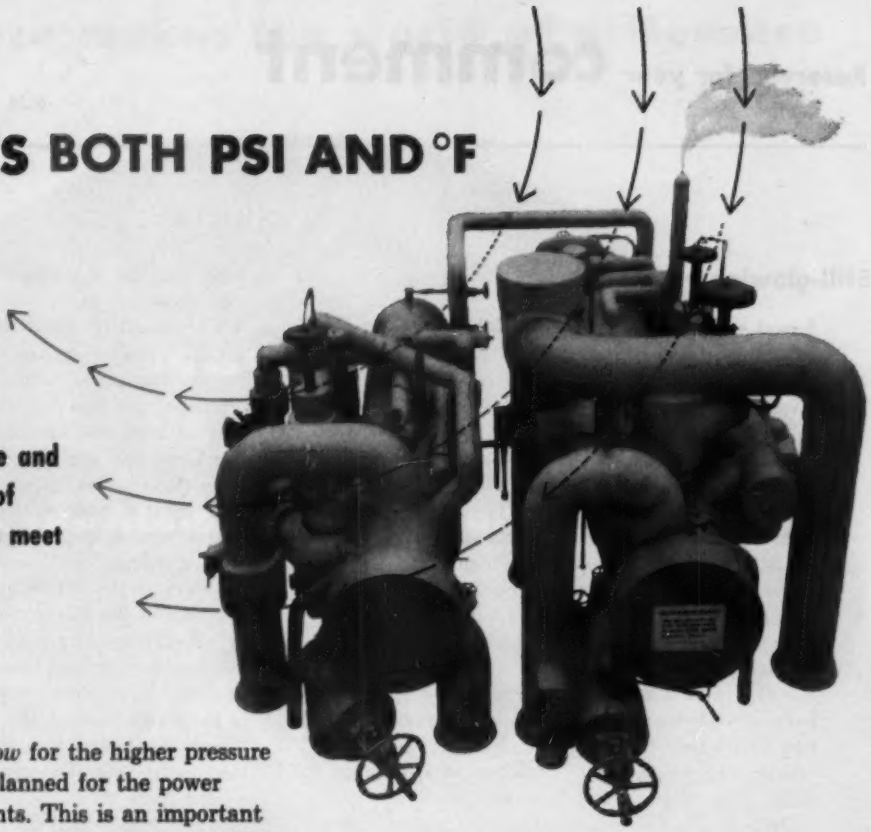
Vallecitos Boiling Water Reactor capacity is being stepped up by General Electric Co. Adding two 10,000-gpm recirculating pumps will double original recirculation rate and raise discharge pressure from 25 to 100 psig. This will raise specific power of UO_2-fueled reactor from 30 to 65 kw per kg. Redesign of core will force greater proportion of water through core rather than around it. Extended surface elements will be tested for their effect on reducing fuel-element core temperatures.

Further testing of steam-condensing system proposed for the vapor-suppression chamber of Pacific Gas & Electric's Humboldt Bay Power Plant has been requested by the Advisory Committee on Reactor Safeguards of the AEC. While Committee believes the design has merit, it feels the vapor-suppression system needs more development effort.

New procedure by AEC now reviews unsolicited proposals for reactors as they are received. The Division of Reactor Development does the review for new systems applying to power, heat generation or any other industrial application. Program aims to: provide theoretical and experimental evidence sufficient for a preliminary determination of technical feasibility, develop a system design, estimate economic promise of a system, establish minimum research and development program to build and run an experimental reactor. Of 12 proposals received between Sept 1, 1959 and March 1, 1960 only one was accepted. This was for the American Radiator & Standard Sanitary Corp to continue studying nuclear and thermal stability of a core for a mercury-cooled breeder reactor.

Proceedings of 1959 Symposium on Low-Temperature Nuclear Process Heat (TID-7580) can now be bought from Office of Technical Services, U.S. Dept of Commerce, Washington 25, D.C. for 75c. Symposium covers: AEC surveys of domestic process-heat needs; technical and economic factors peculiar to low-temperature process-heat reactors; history, objectives and program of experimental low-temperature process-heat reactors; aspect of continued program in developing process reactors; bibliography.

YUBA LICKS BOTH PSI AND °F



Exclusive Multilok Closure and all-welded construction of Yuba Feedwater Heaters meet requirements of newer generating stations

Yuba has the products *now* for the higher pressure and temperature ranges planned for the power industry's new steam plants. This is an important reason why Yuba Feedwater Heaters are so widely specified throughout the industry today. Operating in the 4,000 PSI, 1,000 °F range now, Yuba Feedwater Heaters, incorporating the exclusive *Multilok Closure*, are suited for all future pressure and temperature developments.

Advanced engineering keeps Yuba ahead . . . the new *all-welded construction*, for example. Shells are welded to channels without flanges, eliminating possible leakage that can occur in other construction at high pressures and temperatures. For low and intermediate pressures, Yuba's bolted design is applicable.

When space is important, Yuba can combine several heaters—effectively designing two or more stages in a single shell. For all your needs, Yuba specialists will discuss with you in detail, the design, construction and advantages of Yuba's *years ahead* Feedwater Heaters.

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For more facts circle 243 on Reader Service card, p 103

Reserved for your comment

BOB BELLAS, Associate Editor

Still-glowing embers

I read with great interest George Edwards' article on standardized OE examinations (Dec, p 194). Mr Edwards' timing was considerably better than mine. Twenty-five years ago, in the Sept 1935 issue of POWER, I suggested a universal licensing system, preferably supervised by the Federal Government as the marine licenses are now *(Should engineers have federal licenses?*, p 496).

At that time, quite a lot of discussion came of it —and that was all. Now, more than ever, such a licensing system is desirable in our profession.

A steam generator or unfired pressure vessel is an innocent-looking apparatus. It's difficult for the average person to realize how potentially dangerous it really is. Particularly so when these vessels are built to such high standards that, in many cases, they'll withstand years of abuse. Failure, when they can no longer cope with conditions imposed upon them, often means costly damage.

Owners of power equipment pay for trained operators, whether they have them or not. They pay for them in increased operating and maintenance costs. Sometimes they pay through the nose for trained help, but on paper it's production loss, property damage and, perhaps, human lives lost.

C G ROBINSON, *Dubuque, Iowa*

. . . A standardized stationary engineering licensing system should be developed on a nation-wide basis. It should be comprehensive enough to include local variations in boiler and machinery applications. Despite the wide variety of these applications in the marine field, certificates and licenses are issued to engine-department personnel as a result of uniform examinations.

This also applies to the National Board examinations for boiler and unfired-pressure-vessel inspectors. Standardization has proved to be the best method in these areas.

Stationary licenses issued by each state through adoption of uniform examination procedures appeals as one possible solution. Reciprocal recognition of any other state's equivalent grade of license should, of course, be included.

No valid reason presents itself to justify the present bedlam of geographically isolated stationary-engineering licensing requirements.

J A TREFFS, *Newtown, Conn.*

. . . So George Edwards feels that the operating engineer could use more prestige! Well, there are few in the power-plant industry who would quarrel with that—as is testified by some emphatic opinions expressed previously in your *Comment* pages.

Unfortunately, those who would profit most by greater prestige are the ones who refuse to work for it. Those who would work for it do so half-heartedly; the vast majority do nothing. Moreover, they sit back and let situations develop which further lower any standing and prestige that the operating engineer may possess today.

If the OE was willing to voice loud protests against operating practices he knows are questionable, which common sense tells us are responsible for an important percentage of packaged-boiler failures across the country each year, his importance to industry would grow by leaps and bounds. But the contrary is true, and I'll repeat that lack of prestige in the trade (or *profession*, if you prefer) is the direct fault of the majority of engineers. I believe that license laws should be more uniform in the country, and obtaining a license should be made a little more difficult. This would attract a better qualified man to the job.

I hope this letter produces a bundle of replies, whether or not they agree with me. Main point is to stimulate interest in what is happening around us, and to maintain the highest standards possible for our calling. In this way we could stop worrying about prestige. We'd get it automatically, and it would be earned and deserved.

P E LEONARD, *New York, N. Y.*

. . . Let's look at Canada, where all but two of the provinces have license laws and the licenses are acceptable, in most cases, in the neighboring provinces. Here in the U.S., only eight states have license laws and few states recognize any license but their own.

George Edwards mentioned that the ASME Boiler Code is uniform throughout the land. Why couldn't that same Society of Mechanical Engineers set up a code for examining operating engineers? This would not be any federal, state or city examination, but one instituted by a highly respected engineering society and one which might be readily accepted by state or city governments.

We have 42 states without license laws. The field is wide open. Perhaps the states without license-examination boards would welcome the proposed "ASME Operating License." And a drive to have such a license recognized across the country might bear fruit. We can't have a country-wide uniform license overnight, of course, but we have to start somewhere and the ASME seems like a logical place.

HOWARD LADRACH, *Amherst, Ohio*

continued

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For more facts circle 244 on Reader Service card, p 103

More **comment**

It's your ash

Hats off to your down-to-earth article on fuel-ash corrosion (*Industry's battle with fuel ash*, April, p 83-88). As the manufacturer of a special fuel additive for residual oils developed to combat these very problems, we have long felt that just such a presentation has been very much needed.

Our product is beamed at specific problems and is not meant to be a cure-all or panacea. If we may cite a for-instance, we were able to significantly extend the in-service periods of a couple of large oil-fired steam generators. Big problems were slag-bridging of tubes in the superheater section, air-heater tube plugging and considerable corrosion. Average time without an outage was about seven or eight weeks. Proper administering of a corrective additive directly into the fuel stream showed, by inspection after a 4-month period of use, that the treatment was effective and that the unit could have stayed on the line much longer.

We ourselves have made an effort to convince rather than confuse in our many informal talks to engineering groups throughout New England and upper New York. It seems that many technical papers presented before these groups bypass the medium-sized and smaller steam generators. But it's well known that these operations, too, suffer from the corrosive effects of fuel-oil ash.

We here at Nutmeg will certainly plug your excellent and enlightening discussion of the subject to help promote a clearer understanding of these problems.

ROGER F SUMM, *Director of Service*
Nutmeg Chemical Co, New Haven, Conn.

. . . I have read your *TD* report with extreme interest since roughly 90% of the activities of our organization are directed toward research and consultation on combustion-deposit problems and the use of additives in combating them.

In recent years an ever-increasing number of power-plant engineers have come to realize the value of fuel additives in holding boiler efficiencies at designed levels.

In your report you touched on the use of ammonia as a means of counteracting cool-end corrosion in boilers. This is by no means a recent development. Our technical staff has suggested its use since 1947, and in a form which can put it within reach of every boiler operator, large or small.

We make it available in a triple-attack formulation as safe to handle as ordinary water treatment. Materials used are not only capable of lowering the dew point of acid salts in the cool end of the boiler, but are also beneficial where slag and heavy soot conditions exist.

If possible, we would like to have the opportunity to elaborate on your excellent report and make available to your readers some technical information which has not been publicized and which, we believe, should prove of interest.

T T PECK, *Chief Chemist*
Polyphase Chemical Service, Inc, N. Y.

EDITOR'S NOTE: *We herewith extend an open invitation to Reader Peck in particular, and other* POWER *readers in general, to submit article material for our consideration—not only in connection with our* TD *report on fuel ash, but dealing with any phase of energy-systems operations. Article material must, of course, provide info useful to our readers.*

. . . The comprehensive report on fuel ash points up our similarity of interests. While we are not directly concerned with the fuel-ash problem, we are indirectly concerned with its consequences—adverse effect on extracting every possible Btu from every pound of fuel converted to steam.

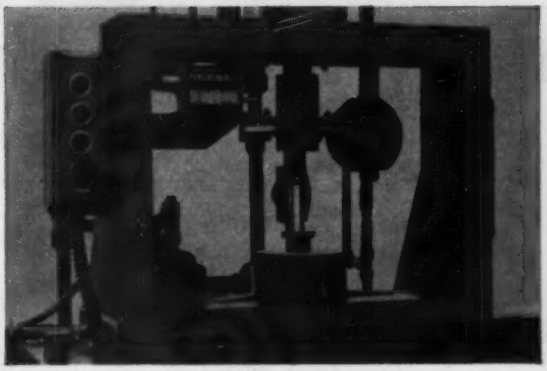
For over half a century we've been stressing conservation and control of steam's heat energy, and articles such as this do much to promote the theme. Congratulations to POWER for continuing to project a dollars-and-cents message to its readers. Knowledge that POWER regards economics as a basic engineering consideration reinforces our belief that we are on the right track with people in our field.
D H HARRIS, *Sarco Company, Inc, New York, N. Y.*

. . . POWER deserves a "well done" for its presentation of *Industry's battle with fuel ash*. Hundreds of technical papers have been presented on the subject of oil-ash and sulfur corrosion and, in fact, one worthwhile paper discusses the gaps in our knowledge on the subject. Assimilating our present known data and then constantly striving for improved metals and fuel-treatment compounds appears to be a never-ending task.

It's my opinion that the addition of metal oxides as slurries in the fuel oil is a stop-gap solution to the problem. While it has met with some success in large central stations, it is not practical for application in the multitude of smaller power-generating and steam-heating plants. This makes a case in point for oil-soluble additives containing inorganic compounds. One further comment: Fuel additives which contain only organic compounds are ineffective in the battle with fuel-ash problems, so the operator needs only to inquire the ash content of any proposed additive to determine its merit in this respect.

Your objective presentation of a tremendously complex subject, within understandably limited space, is a welcome addition to existing literature.

R S NORRIS
R S Norris & Associates, Larchmont, N. Y.



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Wolverine condenser tubes are available in a wide range of sizes in copper and aluminum alloys in prime surface or with integral fins (Wolverine Trufin®). You can also specify both plain and finned duplex and U-bend condenser tubes.

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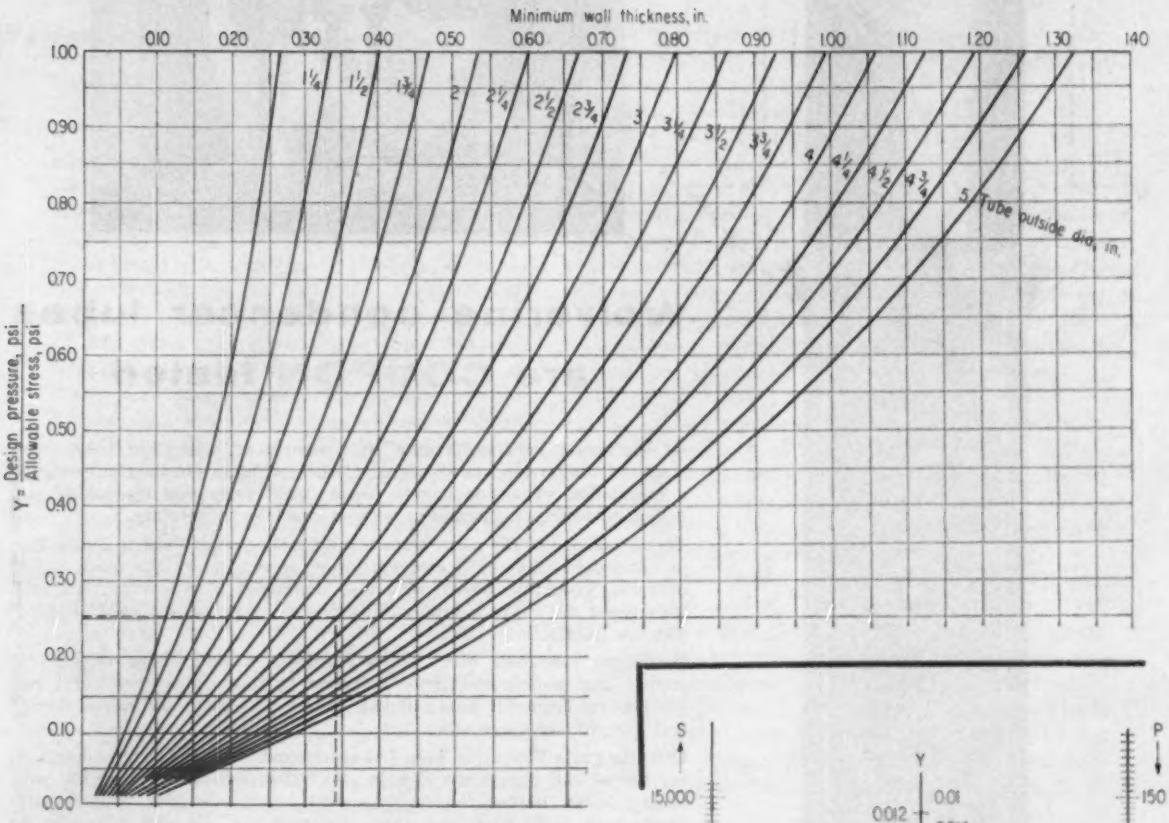
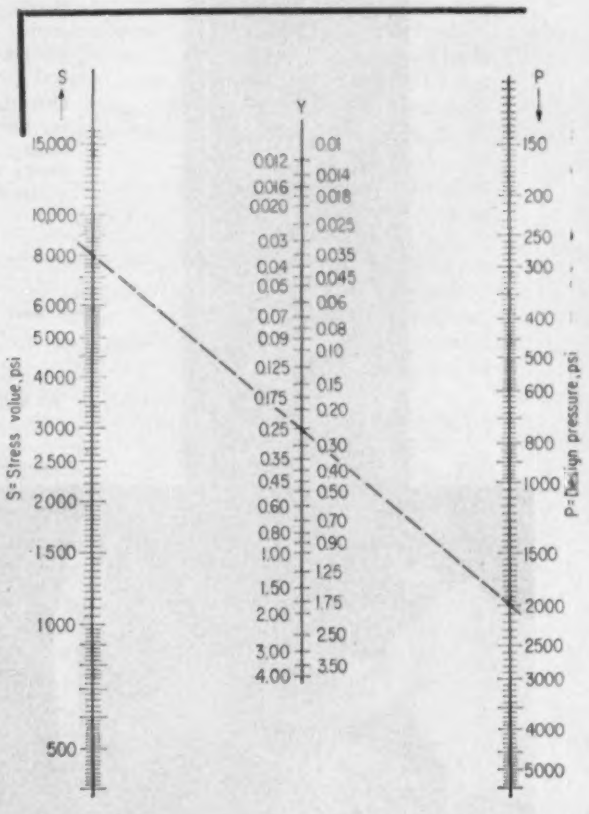
Power's data sheet

No. 333





Minimum required wall thickness for internal-pressure tubing

Calculating the minimum wall thickness of tubes subjected to internal pressure is not hard, but rather time consuming, especially in steam-generator design.

Minimum wall thickness of tubes is based on formula, pp 5-7, Sec I, ASME Boiler and Pressure Vessel Code:

$$T = \frac{Y}{Y+1} \times \frac{D}{2} + 0.0135\,D$$

Where: $Y = \dfrac{P,\ \text{maximum working pressure, psi}}{S,\ \text{allowable stress, psi}}$

Enter nomograph with P and S to find Y. Enter chart at Y value and find required minimum tube-wall thickness for chosen OD, accurate to three decimal places.

Example: For $P = 2000$ psi and $S = 8000$ psi, center scale of nomograph reads 0.250.

Entering chart at $Y = 0.250$ shows minimum required wall thickness of 0.340 in. for a 3-in.-OD tube. Calculated figure comes out to 0.3405 in.

Riley Stoker Corp, Worcester, Mass.
W G Schuetzenduebel, *Development Engineer*

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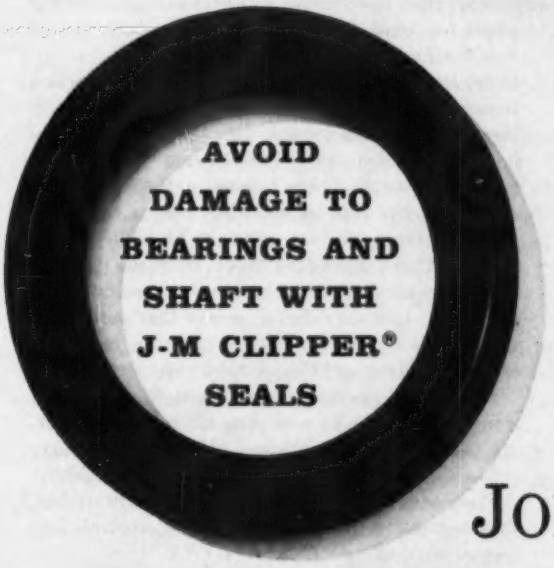

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Technical briefs . . . Latest engineering

Gas turbines: manufacturers and users take another look

Operation and maintenance of remotely controlled gas-turbine units, *R C Hill, R H Hubbell and M L Krapp, Trans-Arabian Pipe Line Company*

Operating experience with several portable gas-turbine-powered pipeline pumps shows 94% availability can be expected. Plants are spread across Arabia and many are remotely controlled through vhf radio system. Telemetering necessary operating information detects trouble. Classification of troubles revealed by telemetering system dictates whether to try restart or if maintenance is required.

Operation and control circuits are described, together with initial difficulties: bearing troubles, bucket erosion and compressor fouling. Portability provisions include transport over desert areas by van type trailers. *ASME 60-GTP-14*

Development experience with prototype gas turbines, *J E Cook, Standard-Vacuum Oil Company*

Initial operating difficulties with newly designed Japanese gas turbines have been largely corrected; an extended period of reliable and economic power is anticipated.

Severe operating conditions aggravated initial difficulties. H_2S content ran as high as 6 or 8% by weight in the fuel gas burned, compared to design value of 3.6%. Turbine-blade cracking was arrested by re-dressing and drilling small holes to stop crack progress. Drilling small holes to increase secondary air reduced carbon buildup on gas nozzles. Fouled compressor blades were cleaned by the scouring action of 200-mesh spent catalyst injected with units in service.

Operating experience showed need for excess capacity over maximum load requirement of 15 to 20% to allow for compressor fouling and seasonal rise in ambient. *ASME 60-GTP-13*

The behavior of gas-turbine combustion chambers while burning different fuels, *C Kind, Brown-Boveri Corporation, Switzerland*

In many types of installations it becomes desirable to change gas-turbine fuel—for example, from a gas to a liquid. Ability to do this easily without major burner and combustion-chamber modification gives a high degree of operating flexibility. Widely differing burning characteristics must be taken into account when designing the combustion chamber.

Since low-flame temperature is desirable for satisfactory combustion-chamber-wall life, considerable excess air is needed, especially with luminous-fuel-oil flames. Amount of air for fuel-oil combustion would be too much for blast-furnace gas.

Several European and Near Eastern examples cover operation with a variety of fuels. *ASME 60-GTP-10*

Gas-turbine-exhaust heat-recovery cycle, *G L Morris, Brown and Root, Inc*

Comparative evaluation of four heat-recovery cycles shows best selection for a particular industrial installation. Each cycle met process requirements, and was evaluated on basis of reliability, flexibility, availability and economy. Cycle arrangements were (1) single combined-recovery-power boiler (2) two combined-recovery-power boilers (3) two recovery boilers and one 35,000-lb-per-hr power boiler and (4) two recovery units and one 70,000-lb-per-hr power boiler. Arrangement (2) was most expensive; (4) cost least.

Arrangement (4) was selected and modified to provide the following major elements: (1) two 7500-hp simple-cycle gas turbines driving process equipment (2) two 30,000-lb-per-hr pressurized recovery boilers complete with economizers and (3) two 40,000-lb-per-hr power boilers capable of using either air or turbine exhaust for combustion air. *ASME 60-GTP-9*

A rapid-starting automatic gas-turbine generating plant for peak-load duty, *B G Markham, Bristol Siddeley Engines, Ltd, England*

Development of gas turbines for peaking service is traced in England and compared to U.S. practice. Basic requirements for low-duty factor are low capital and standby costs. Older steam units fail on latter because they can't meet unforeseen peaks quickly unless kept as spinning reserve.

Automatic gas-turbine units can fill both requirements. High-temperature types at about 1/3 the cost of equivalent low-temperature machines are discussed. Low-duty factor means that capital investment is by far the major expense; fuel costs can run as low as 10% of total cost.

Location of gas-turbine peaking stations can save transmission costs by providing alternate feeds during emergencies or planned outages. This may reduce line requirements for desired reliability.

Plant and equipment for a 3-mw unit is described, stressing automatic startup, governing, controls and compressor fouling. *ASME 60-GTP-2*

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SYSTEM GROWTH

developments for busy power men

Economics of the steam-gas turbine exhaust-fired cycle for medium-sized utilities, *M Eisler and W M Sybert, Kaiser Engineers*

Steam and gas-turbine-exhaust fired cycles permit "building-block" approach to system generation expansion. Since simple-cycle gas turbines operate with about 500% excess air, turbine exhaust is suitable for use as hot combustion air in steam boilers. Using this gas-turbine-exhaust heat gives combined plant output slightly in excess of individual gas and steam cycles operating separately.

Building-block concept of system generation growth involves alternate additions of suitably sized steam and gas turbines. These operate alone at first, but are later combined with future additions. System growth then more closely follows load growth, cutting excess capacity inherent with large unit additions.

Two examples illustrate economics of the building-block concept. *ASME 60-GTP-15*

Cavitation

On cathodic protection in cavitation damage, *M S Plesset, California Institute of Technology*

Experiments with transducer-induced cavitation permit accurate and reproducible determination of cavitation damage. Comparative tests can be made to show effect of cathodic protection on cavitation.

In a 3%-NaCl solution, a test specimen was made the cathode of an electrolytic cell; H_2 gas evolved at specimen surface. In distilled water, specimen was made the anode and O_2 gas evolved—here, of course, current was doubled since valence of oxygen is twice that of hydrogen.

Evolved gas in both cases reduced cavitation damage (loss of weight), apparently because of cushioning effect of gas at the specimen surface. Comparative test results, with and without gas evolution, are charted to show loss of weight, current and test duration. Test apparatus is detailed. *ASME 59-A-170*

Investigations in Czechoslovakia on electrical phenomena during cavitation and electrical methods of protection against cavitation, *J Noskievic, U.S.S.R.*

Cavitation tests on hydroelectric-turbine runners revealed effectiveness of cathodic-protection measures. Cavitation was associated with a change in surface electric potential. This is attributed to actual metal heating caused by cavitation.

Two distinct phases of cavitation seem to exist: (1) incubation stage involves no loss of weight, but metal becomes fatigued and electromechanical corrosion occurs (2) with surface cleanliness thus impaired, loss of weight results. Tests showed that cathodic protection delays start of second phase, but once loss of weight begins, cathodic-protective measures have little retarding effect.

Several other studies involving relationships between cavitation and cathodic protection are cited. These include tests of nozzles, vibrating metal specimens, hydraulic-turbine runners and water-jet impact. *Teploenergetika, 1959, No. 7 (3 pages)*

Some corrosion effects in accelerated cavitation damage, *W C Leith, Dominion Engineering Works and A L Thompson, McGill University, Canada*

Historical theory of cavitation is traced through references to show evolution of current thinking. Discussion covers mechanical vs electrochemical theories of cavitation.

Study shows relative effects of metal properties (hardness, metallurgical structure and corrosion-fatigue limit) and liquid characteristics (temperature, pressure and wettability). Test results are graphically presented to indicate range of testing as well as quantitative results. *ASME 59-A-52*

An effect of air content on the occurrence of cavitation, *J W Holl, The Pennsylvania State University*

Between noncavitating and profusely cavitating flows lies the relatively unexplored area of limited cavitation. Within this range, incipient cavitation is attained by gradually lowering stream pressure to the point where first evidence of cavitation is noted; desinent cavitation is attained in the reverse manner, by raising the pressure in a flow stream to the point where cavitation ceases.

These and other laws of cavitation are defined fully since a study of the effect of air depends on their clear understanding.

Hydrofoil tests are discussed and charted. One conclusion drawn from tests: difference between desinent-cavitation numbers for gaseous and vaporous cavitation is directly proportional to dissolved-air content and inversely proportional to square of velocity. *ASME 60-Hyd-8*

continued

Directions for ordering these papers on page 102

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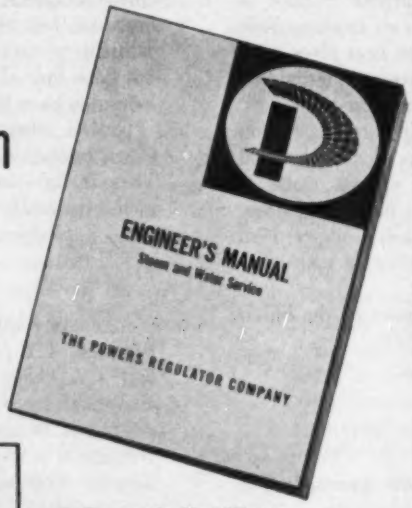

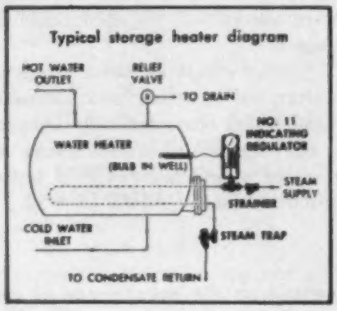

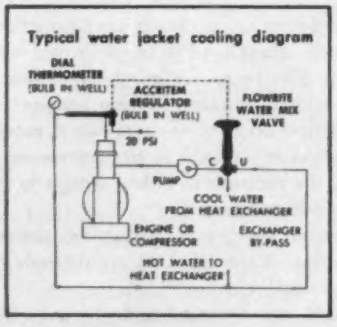

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Technical briefs

Begins on page 94

Russian gas turbines

The development of high-output gas turbines, *E A Manushin and O M Pankov, Moscow School of Higher Technical Education*
Largest gas-turbine sets currently in production are 100-mw units built by the Leningrad Metal Works. Theoretical investigations show feasibility of sets over 300 mw at 1290 to 1350 F.

Increased output is possible through: (1) increased axial velocity at exhaust end and use of diffusers (2) replacing regenerators with coolers and intermediate combustion chambers with simultaneous pressure increase to 850 to 1140 psig (3) generators driven from high- and medium-pressure shafts.

Outlet velocity from present 100-mw sets is 430 ft per sec. Increase to 860 ft per sec raises output to 195 mw. Diffuser will hold exhaust losses to about 0.22 Btu per lb. Other factors are discussed and compared to existing Soviet and Swiss designs. Study shows that 39% efficiency is possible with 600-mw double-flow-exhaust design. *Teploenergetika, 1959, No. 10 (10 pages)*

Test results on a gas turbine type GT-12-3 installed in the Shatskaya Station of Podzemgas. *G G Ol'khovskiy and G I Shuvalov, All Union Thermo Technical Institute, U.S.S.R.*
First tandem 12-mw gas turbine made by Leningrad Metal Works was tested in 1958. It is designed to operate on liquid fuel and gas from underground gasification of Moscow Basin coal.

Although test results didn't come up to design, experience gained permits a start on 25- and 100-mw sizes. Test results and design targets are shown. Design efficiency at 11.4 mw was 27%, but only 23.4% was realized. Degree of regeneration and air leakage are blamed for this deficiency. Other operating difficulties included turbine-blade coking and formation of water vapor in intercoolers. *Teploenergetika, 1959, No. 10 (6 pages)*

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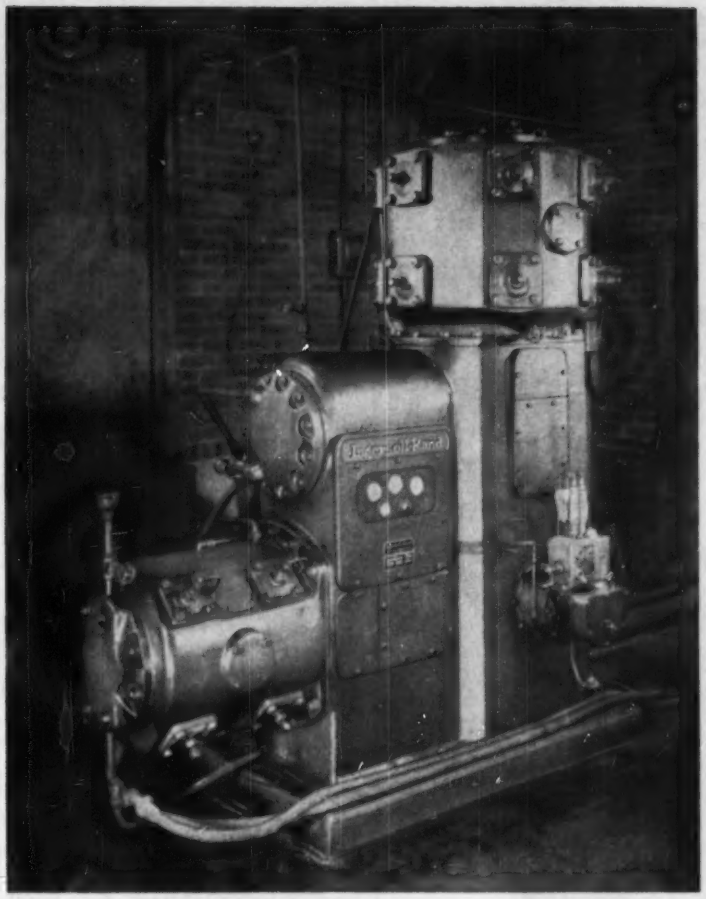

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The XLE compressor had been purchased largely because of good performance of other I-R equipment in the same plant, including three different types of compressors and a variety of pumps.

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Technical briefs

Begins on page 94

The use of high-output gas turbines at peak-load power stations, *G G Ol'khovskiy and V D Starichenko, Engineers, U.S.S.R.*
Foreign use of gas turbines for peaking is reviewed—in U.S.A., England, Italy and Germany. Suitable units in the 20- to 40-mw range are usually provided without regeneration and have comparatively low efficiencies (20 to 27%).

Advantages cited for gas turbines on peaking service are low cost, space economy, simplicity, reliability and rapid remote startup. *Teploenergetika, 1959, No. 10 (5 pages)*

System growth

How planning for growth paid off. *E C Siddons, American Cyanamid Company*
In planning for electrical growth, management does not permit large capital investment far in advance of actual growth needs. System to be installed now must be designed so that later additions can handle growth at minimum cost.

Two bases of electrical-distribution systems lend themselves readily to this management requirement: (1) a primary-selective radial system where two primary feeders are brought to each substation and switching is arranged to connect load to either feeder (2) loop arrangement where subs are arranged in series with switching equipment permitting flexible operation.

Early growth studies considered (1) continuity (2) flexibility (3) simplicity (4) low first cost (5) economy (6) capacity for expansion (7) adaptability to purchased or locally generated power and (8) minimum maintenance.

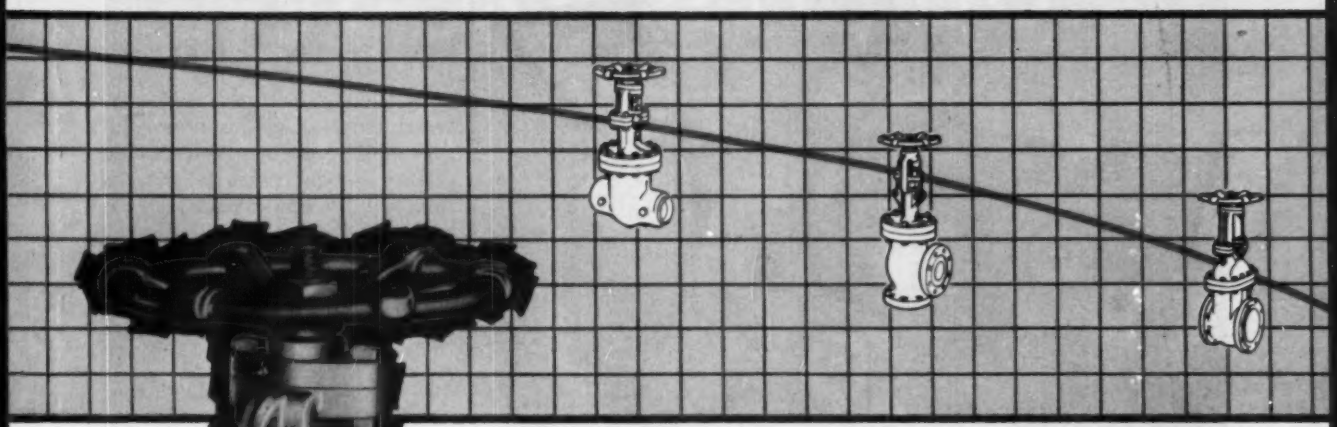
On these bases several old distribution systems were revamped for growth—details are given. Ease of subsequent growth is traced to show how planning paid off. *AIEE CP-60-449*

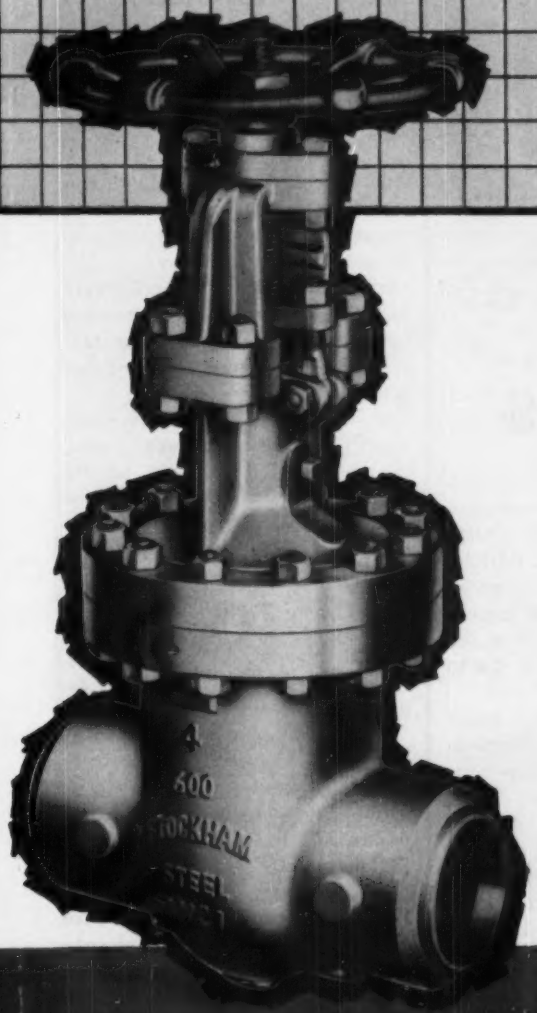
The use of simulated reserve margins to determine generator installation dates, *C J Baldwin and D P Gaver, Westinghouse Electric*

For more facts circle 249 on Reader Service card, p 103 circle 250 on Reader Service card, p 103 ▶

Engineered to Cut Valve Maintenance Costs

STOCKHAM STEEL GATE VALVES





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Technical briefs

Begins on page 94

Corp and C H Hoffman and J A Rose, Public Service Electric and Gas Co

Installation dates for new capacity are determined using simulated daily reserve margins as available from operational gaming studies. But average percent margin should not be used alone as a measure of service reliability. Dispersion of margin by load and capacity fluctuations is also an important factor.

Required installation dates obtained are random quantities. But advancing a new unit scheduled on average expected risk a few months reduces probability of inadequate capacity to a very conservative value.

When combined with other simulation results and economic analyses, this consistently compares alternate expansion patterns. *AIEE 60-251*

An approach to peak-load economics, *S D Galloway, L K Kirchmayer, W D Marsh and A G Mellor, General Electric Company*

Current importance of peak-generation methods results from lessening improvement of large-unit heat rates and the array of new forms of thermal generation now available.

System investment costs are only slightly affected by savings in peaking-unit installed cost and are frequently offset by increased fuel cost in less-efficient unit. Machine operation does not agree exactly with load-duration curves, but must meet spinning-reserve requirements and be made available as planned and forced outages permit. A "load triangle" shaped to fit reasonable operation has merit in system planning.

Using this approach to peak planning with necessary assumptions, digital-computer programing is set up for a life up to 30 years. Realistic results can be used with considerable confidence. *AIEE 60-256*

Load and capacity models for generation planning by simulation, *C J Baldwin and C A DeSalvo, Westinghouse Electric Corp and C H Hoffman and E C Plant, Public Service Electric and Gas Corp*

System planning by simulation or operational gaming can take into ac-

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Technical briefs

Begins on page 94

count spinning reserve policy and maintenance programs as well as load growth.

Determination of daily peak loads starts from long-term trend of summer peaks. Deviations produce actual summer peaks. From here predicted average monthly peaks lead to actual daily peaks and daily forecast errors.

Forced-, scheduled- and periodic-overhaul-outage simulation is carried out. Daily available capacity is installed capacity plus interconnected capacity minus outage.

Formulas for each load-forecast step are given for solution on digital computer. *AIEE 60-156*

To obtain complete text

Material for these abstracts comes from the following sources. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Contact ASME, 29 W 39th St, New York 18, N. Y. Members, 40c; nonmembers, 80c.

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Russian papers. For complete English abstracts contact Office of Technical Services, U.S. Dept of Commerce, Washington 25, D.C. Price: 70c. For complete papers in Russian contact Chief, Photoduplication Service, Library of Congress, Washington 25, D.C. Price: $1.80 for 1 to 10 pages, $3.30 for 11 to 20 pages, $4.80 for 21 to 30 pages.

Largest generator ever made in Spain is 26,500-kva vertical-axle unit constructed by General Electrica Española. It will be installed at Pont de Rey hydroelectric project.

Electrical-engineering graduates from U of Maine earned average of $525 per month in '59. This is highest average of earnings of '59 graduates from Maine University.

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New free literature

AIR CONDITIONING AND VENTILATION

101 **Separator modules,** graphite entrainment type for separating entrained liquids from corrosive gas streams, are topic of 2-p catalog supplement S-6900. Union Carbide Corp, National Carbon Company Div

102 **Gas scrubbers and cyclones,** firm's complete line, are covered in 12-p bulletin 4R. Application, construction and operation info is given. Schutte and Koerting Co

103 **Air-conditioning units,** vertical and horizontal types, are announced in catalog 54C9c. Specs, dimensions, arrangements and installation instructions for units rated 1200 to 84,800 cfm are included. Recold Corporation

104 **Dry dust-control equipment** is featured in 28-p catalog 806. This shows ways of using cloth filtration and cyclonic equipment to eliminate dust-control and air-pollution problems. Fuller Company, Dracco Div

105 **Dust collectors** are discussed, list of typical industrial applications is included in bulletin 1828. American-Standard Industrial Div

METALS AND MATERIALS

106 **Nickel-chromium alloy** for wire-wound resistors, potentiometers is detailed in 8-p alloy data bulletin 111. Hoskins Mfg Co

107 **Aluminum-bronze alloy** especially for users of bronze welding electrodes is featured in product-news bulletin. Ampco Metal, Inc

108 **Liquid for destaticizing plastics,** polyethylenes is suggested for use on lighting fixtures. Complete data is given in sheet 5. Merix Chemical Company

109 **Standard designations** and chemical-composition ranges for heat- and corrosion-resistant cast alloys are topic of ACI booklet. Alloy Casting Institute

110 **Fibrated epoxy-mastic** coating for equipment and structure protection is topic of bulletin 540A. Prufcoat Laboratories, Inc

111 **H-t laminated plastics** are covered in engineering bulletins. Synthane Corporation

112 **Uses for rubberized adhesives** are subject of new application manual. Cratex Mfg Co, Inc

MATERIALS HANDLING

113 **Permanent magnetic pulleys** for removing tramp iron and small-iron contamination are described in new-product bulletin. Eriez Manufacturing Company

114 **Roller chains** and sprockets are detailed in 44-p booklet 2757. Indexed for easy reference, book covers stock sizes, info on pitch-power transmission and conveyor chains. Link-Belt Company

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115 **Belt-conveyor idler** is covered in well-illustrated 20-p bulletin LD-111. Unit is improved version of original 2-bearing catenary idler. Joy Mfg Company

ELECTRIC GENERATION TRANSFORMATION AND CONVERSION

116 **Emergency electric-generating** plants and controls are topic of 8-p selection and installation guide. D W Onan & Sons Inc

117 **Dry type transformer** with rating through 15 kva, 600 v is introduced in descriptive bulletin S-202-C. Standard Transformer Co

118 **Silicon rectifier-conversion** unit is announced in 4-p bulletin GEA-7060. Photos, cost charts, ratings, application and price tables are included. General Electric Company

119 **Voltage regulators** for ac generators and generator exciters are featured in 4-p bulletin. Fidelity Instrument Corporation

ELECTRICAL DISTRIBUTION AND PROTECTION

120 **Use of dc high-potential** test set for preventive maintenance of power-distribution cables and other electrical gear is discussed in bulletin 5-60.3. Associated Research, Inc

121 **H-v switch cubicle** is described in 12-p bulletin. Info on operation and maintenance of load-break switch is included. Allis-Chalmers Mfg Company

ELECTRICAL APPLICATION

122 **Maintenance testing** of insulation resistance is discussed in 32-p manual. Chart for keeping records of resistance measurements on each piece of equipment is illustrated. Associated Research, Inc

123 **Electrical paper insulation** is covered in well-illustrated bulletin. Minnesota Mining & Mfg Co, Mica Insulator Div

124 **Asbestos-cement materials** for electrical board panels are described in 4-p folder IN-229A. Johns-Manville Corporation

125 **Vaportight lighting fixtures** are introduced in 4-p bulletin 652. The Pyle-National Company

126 **Polyvinyl-chloride compound** and its application in wiring are discussed at length in 4-p bulletin. Alcoa, Rome Cable Div

127 **Multishielded dripproof motors** are topic of 4-p bulletin. Sterling Electric Motors, Inc

128 **Battery chargers** for motors and generators are announced in 8-p bulletin. Sections cover installation, adjustment and operating methods. The Electric Storage Battery Co, Exide Industrial Div

HEAT EXCHANGE AND CONDENSERS

129 **Firm's complete line** of condensers is outlined in catalog 34C9A. Recold Corporation

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NEW FREE LITERATURE continued.....circle key numbers, page 103, for your copies

130 **Air-cooled condenser** catalog features specification and application analyses. Four types of units are discussed in this 12-p catalog AC-103. Halstead & Mitchell Company

131 **Organic heat-transfer fluids** and seal-less canned pumps are detailed in 9-p technical bulletin 6. Fostoria Corp, Chempump Div

132 **Feedwater heaters** are topic of 16-p bulletin YHT 102. Design and construction features are described. Yuba Consolidated Industries, Inc

INSTRUMENTATION

133 **Boiler control** on all-outdoor 850-psig 900-F unit at municipal lighting plant in Taunton, Mass. is described in 12-p bulletin 1065. Blaw-Knox Company, Copes-Vulcan Div

134 **Boiler safety device** combines float action and electrode-operated functions in common water chamber. Details are in catalog section D2.5. The Reliance Gauge Column Company

135 **Automatic control systems** for ion-exchange equipment are subject of bulletin E-359. Illinois Water Treatment Company

136 **Electronic computing system** is described in 6-p brochure S-482. Royal McBee Corp

137 **Portable and hand tachometers** are featured in 2-p bulletin. The Electro-Mechano Co

138 **Supervisory-control system** is outlined in 12-p well-illustrated brochure. Operating sequences are shown in detail. Electro-Mechanical Research, Inc, Ascop Div

139 **Transmitter and receiver** equipment for remote temperature control is introduced in bulletins 371, 371-1, 371-2. Transmitter transduces temperature measurement into a 3- to 15-psi air-pressure signal from remote location. The Powers Regulator Company

140 **Digital components** and systems are featured in 8-p booklet describing firm's background and facilities. Technitrol Engineering Company

141 **Data loggers** are described in new-product bulletin. Units of various sizes, capacities are included. Hanson-Gorrill-Brian, Inc

142 **Electronic data-processing** computer system is detailed in 12-p publication CPB-81P. General Electric Company

143 **Differential-pressure indicator** is introduced in data sheet. Hastings-Raydist, Inc

144 **Vacuum gages** are detailed in catalog 175. Units are heated-thermopile type. Hastings-Raydist, Inc

WELDING

145 **Manual welding equipment** is covered in 20-p catalog F-8982E. Ordering info is given. Linde Co

146 **Hot-running welding cables** and connections, causes and cures, are discussed in 4-p bulletin. This contains field-tested info on how to maintain welding equipment and electrical connections. Tweco Products, Inc

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Condensate, which might otherwise be a source of trouble, flows down the bypass channel instead of down the port channel. This permits the center plate to retain a relatively high temperature so that water in the ports is nearer to temperature of water in the boiler drum, improving indication accuracy. Absence of condensate in the ports assures a distinct Bi-Color image—signal red for steam—signal green for water.

Multi-Port construction greatly reduces gauge maintenance costs. Inherent thermal stability minimizes maintenance frequency and any port can be changed in a few minutes without removing the gauge from the boiler. Change of any port is expedited by new glass and gasket package unit. Construction is exceptionally sturdy—gauge body is machined from a solid block of high grade stainless steel. Get in touch with your local Diamond office, or write us at Lancaster, Ohio, P.O. Box 415, for complete information and bulletins.

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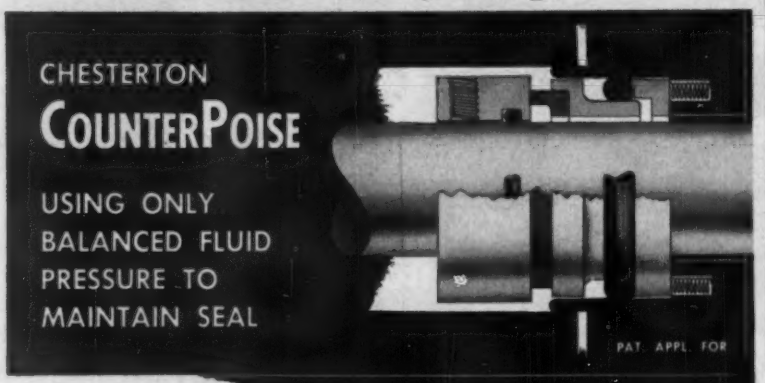

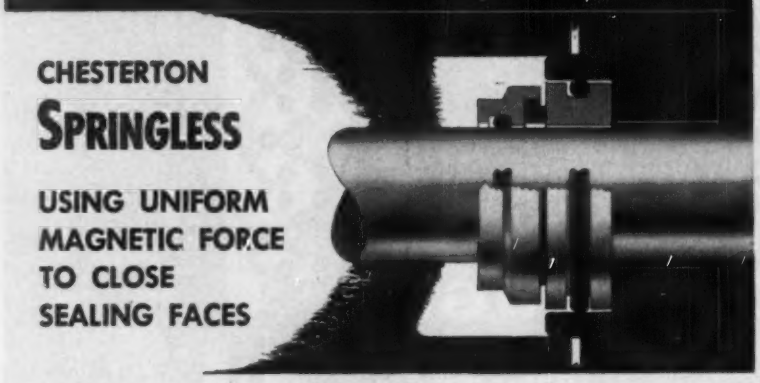

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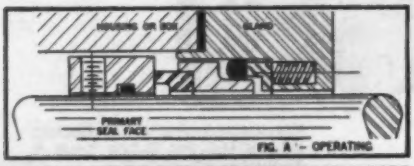

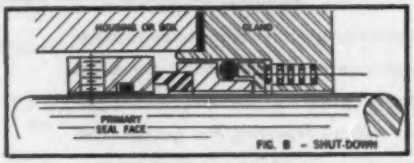

When the COUNTERPOISE SEAL *is in operation (fig. A) springs are disengaged and the sealing faces are held in contact by uniform fluid pressure only! During shut-down (fig. B) springs are in operation, taking over the closing function normally maintained by fluid pressure when the pump is in operation.*

Both new seals operate on the sound principal that sealing faces should *not* be mated by the unreliable and uneven pressures of springs. Conventional springs become fatigued, clogged by sediment or corroded thus causing uneven face wear. A warped face rapidly loses its sealing action. In the CHESTERTON COUNTERPOISE SEAL the fluid pressure maintains a uniform, balanced face pressure eliminating unevenly worn faces. The springs only operate during shut-down or sudden vacuum conditions. They are isolated from corrosive fluids or abrasives. Become acquainted with the newest and most advanced seals in industry by sending for our brochures and then decide which of these two ingenious seals will solve your problem.

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America's Oldest Manufacturer of Mechanical Packings

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Free literature

Begins on page 103A

LUBRICATION

147 **Centralized systems** of lubrication, firm's complete line, are detailed in 24-p booklet 26-T. Principles of operation, system components are discussed, illustrations of typical applications included. Eaton Manufacturing Company, Farval Div

148 **Lubricating-oil spray** especially for preventing rust is topic of 2-p data sheet. Mitchell Chemical Co, Inc

MAINTENANCE

149 **Corrosion inhibitor** produces protective film on exposed metal surfaces. Well-illustrated 6-p brochure HSP-922 gives details. Hagan Chemicals & Controls, Incorporated

150 **Ultrasonic cleaning equipment** for flat and convoluted metal filter-element surfaces is described in 22-p technical report. Aircraft Porous Media, Inc

151 **Equipment - quieting materials** are covered in 20-p brochure including graphs, tables, nomographs, selection guide. Owens-Corning Fiberglass Corp

MECHANICAL POWER TRANSMISSION

152 **Permanent magnet pulleys** in range of sizes from 12 to 48 in. in dia are topic of bulletin 1022. Pulleys can be used for tramp-iron removal, separation and cobbing. Chart aids selection. Stearns Magnetic Products

153 **Shaft-mounted units** are described in 64-p bulletin A692. Reducers for flange mounting, vertical shafts, right-angle and screw-conveyor drives are included in description. Guide aids selection. Dodge Mfg Company

154 **Motor couplings** are described in leaflet 2875A. Couplings have corrosive duty covers of polypropylene for operating conditions when chemical attacks could occur. Link-Belt Company

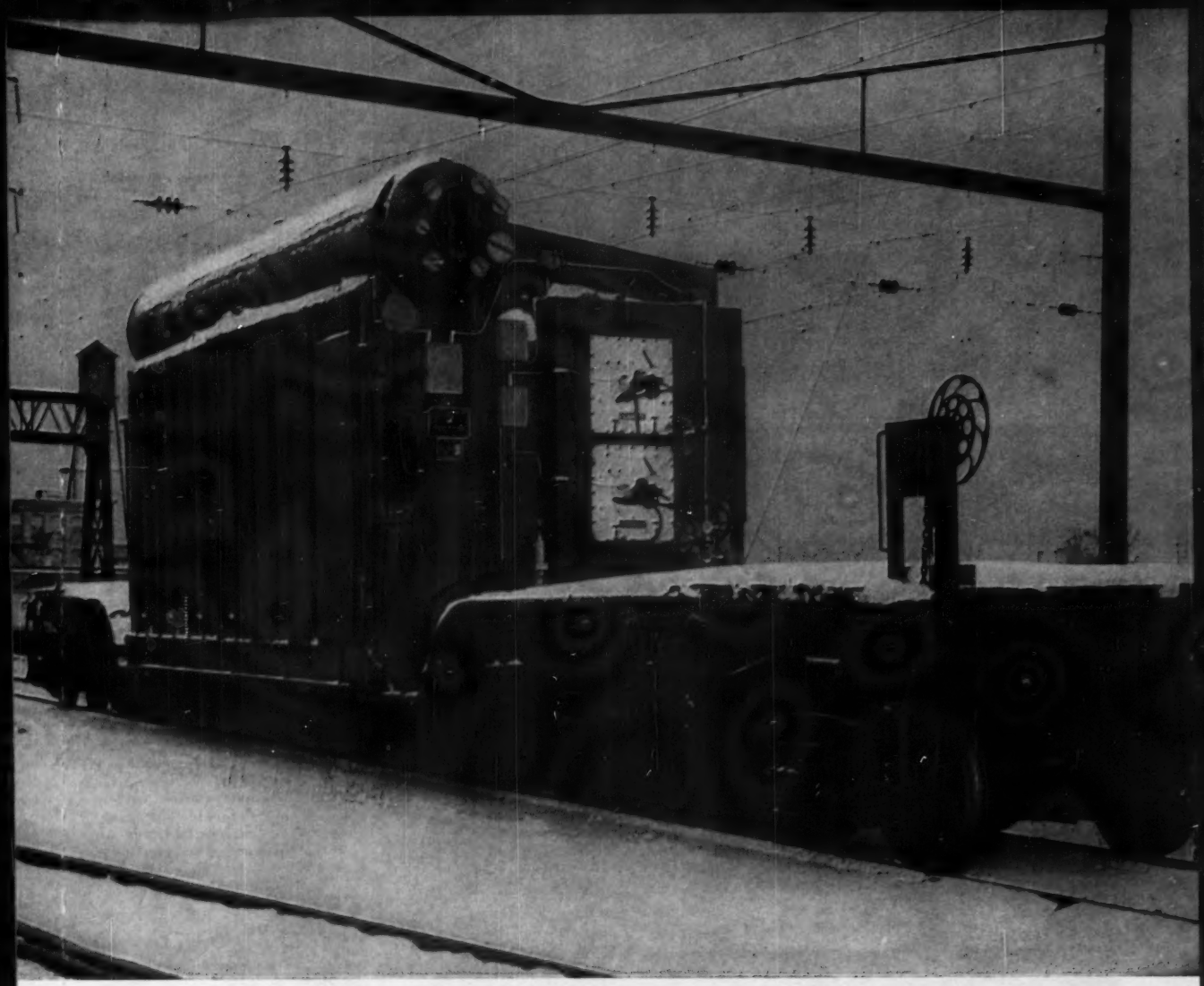
155 **Flexible-coupling catalog 60** supersedes catalogs 51, 51A. Description of misalignment, selection guide are given. Thomas Flexible Coupling Company

156 **Flexible coupling**, coupling with zinc-alloy flanges are covered in 10-p bulletin 5103. Engineering data is given. T B Wood's Sons Company

157 **Coupling** is announced in new-product brochure; specs included. Van Gelder Mfg Co

For more facts circle 255 on Reader Service card, p 103

circle 256 on Reader Service card, p 103 ➤



Special purpose application...a standard steam package

This Foster Wheeler packaged steam generator is standard in virtually every respect except for its unusually high design pressure. The AGX-series unit shown here will deliver over 65,000 lb of steam per hr to test high pressure steam turbines at DeLaval Steam Turbine Company, Trenton, N. J. The Foster Wheeler AGX-series packaged units are designed to operate at pressures from 901 to 1,350 psi.

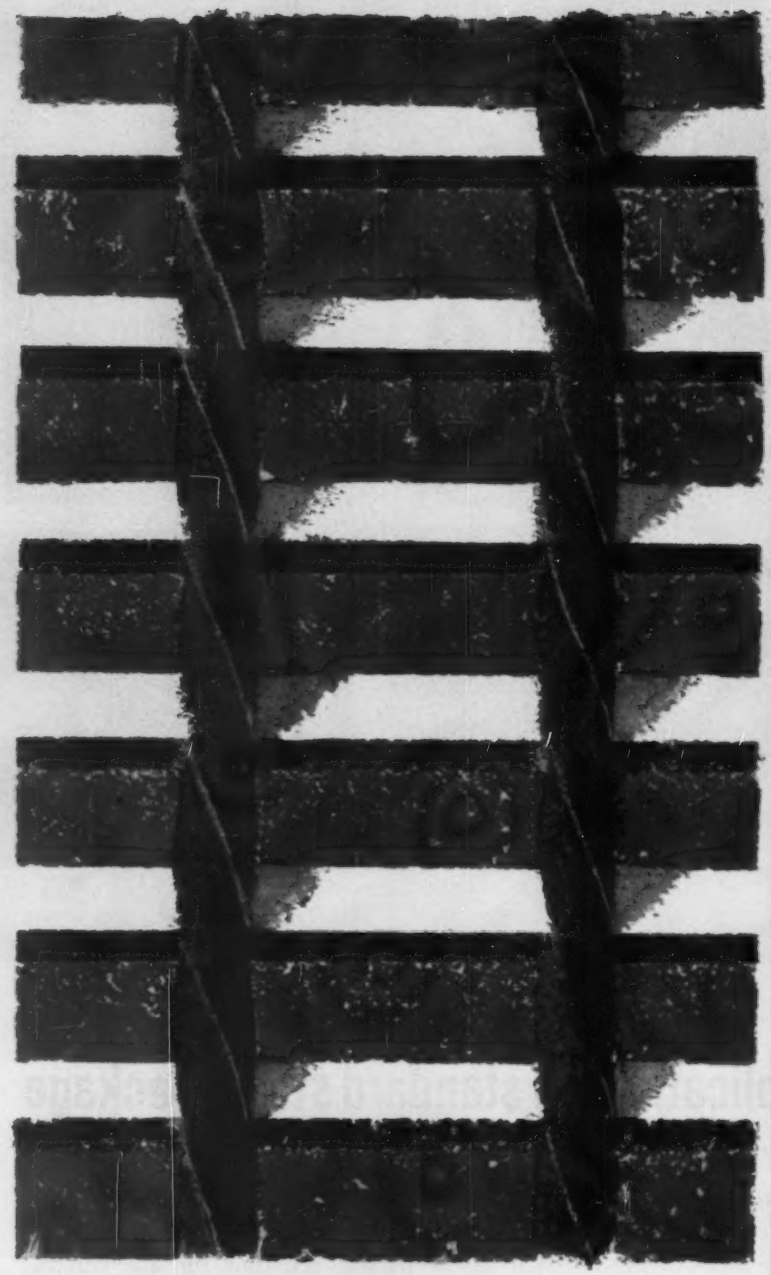
Don't let out-of-the-ordinary steam requirements keep you from considering the economy and convenience of a packaged steam generator installation. The proven basic design of standard Foster Wheeler steam generators allows you wide latitude for adapting to special needs.

Look at the features you have to work with. High steam purity, generous furnace volume, highly efficient convection tube bank, liberal drum size, removable drum internals, to name only a few. All necessary standard equipment is included.

There's no better or more complete packaged steam generator design available today at a comparable cost. Write for FW bulletin PG-58-2 *before* you write specifications for *any* steam generator from 13,000 to 100,000 lb/hr capacity at pressures from 270 to 1,350 psi. Foster Wheeler Corporation, 666 Fifth Ave., New York 19, N. Y.

FOSTER WHEELER

NEW YORK LONDON PARIS ST. CATHARINES, ONT.



Blaw-Knox Electroforged Grating solves so many problems for so many industries. Catalog free on request. Write Blaw-Knox Equipment Division, Pittsburgh 38, Pennsylvania.

BLAW-KNOX

GRATING

For more facts circle 257 on Reader Service card, p 103

Free literature

Begins on page 103A

158 **New line** of V-belts is covered in price sheet V-358-A. Browning Mfg Company

159 **Tapered roller-bearing pillow** blocks are featured in bearing-unit bulletin BU-103-A. Browning Manufacturing Company

160 **Cylindrical roller bearings** are discussed in 12-p bulletin 114. Dimension, load and application info is given. Hoover Ball and Bearing Company, Bearing Div

PUMPS

161 **Cost-savings advantages** of submersible rotary pumps in storage-tank service are described, typical installations included, in 4-p folder. Sier-Bath Gear & Pump Company

162 **Chemical-feed pumps** with controlled capacity are detailed in catalog 200. American Meter Company, Pump Div

163 **Controlled-volume pumps** solved problem of metering softening agent into distribution lines at two Texas pumping stations. Story is in data sheet D-59-1. Milton Roy Company

STEAM GENERATION

164 **Watertube packaged boilers** are described in new-product bulletin 4010. Boiler's built-in controls are discussed. Vapor Heating Co

165 **Packaged automatic boilers** are described and illustrated in 4-p brochure. Line includes sizes from 20 to 100 hp, fired by oil, gas and combination gas-oil. Orr & Sembower, Inc

166 **Automatic horizontal boilers,** Scotch marine type, are explained with specs in 12-p catalog 120. Units are rated 10 to 100 hp for 100- to 125-lb max working pressure. Lookout Boiler & Mfg Co

167 **Packaged boiler,** light-oil-, gas- and combination-fired type, is announced in 4-p catalog. Cleaver-Brooks Company

168 **Forced-draft square-heat** packaged boiler-burner units for oil, gas or combination firing are detailed in 4-p form 1145. American-Standard Industrial Div

169 **Firm's line** of fuel-burning and auxiliary equipment is covered in 12-p catalog 6260. Selection of fuels and types of drafts are included in discussion. Iron Fireman Manufacturing Company

continued

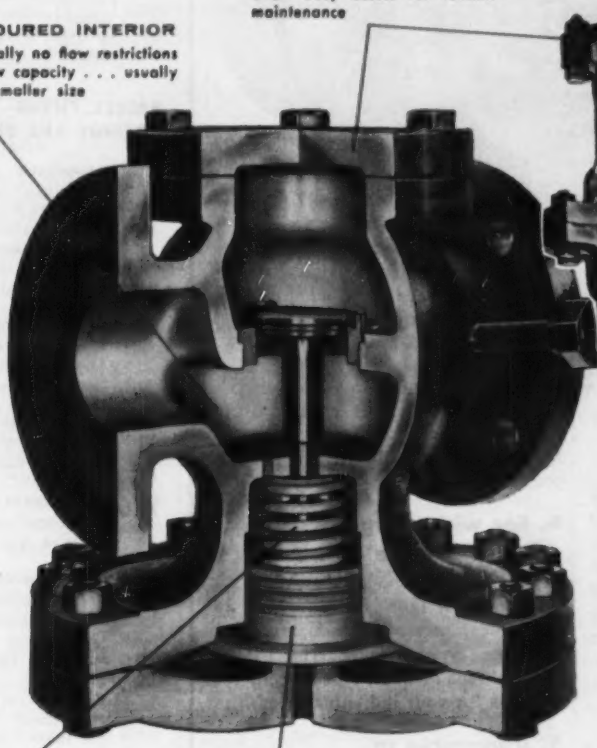
NEW... from K&M

EXTERNAL PILOT-OPERATED PRESSURE REGULATOR

fast-acting, accurate . . . tight shut-off even on dead-end service

Examine it yourself . . . feature for feature. K&M has made a vast improvement in external pilot-operated pressure regulators.

It simplifies installations: *requires one less pipe line.* It offers lowest maintenance: *the result of good hydraulic and mechanical design throughout.* It gives excellent performance: *try one and compare with any other regulator of its type.*



BUILT-IN STRAINER
protects pilot from scale, dirt, other foreign matter, is removable for cleaning

BLIND FLANGES
on both main valve and pilot allow easy access for routine maintenance

CLEANLY CONTOURED INTERIOR
has no spider, practically no flow restrictions . . . gives greater flow capacity . . . usually permits economy of smaller size

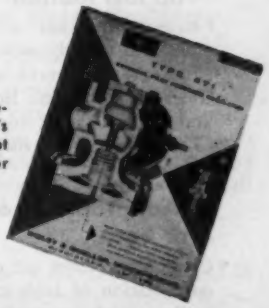
INTEGRAL BLEED ORIFICE
eliminates need for installation of extra bleed line

PRESSURE-ADJUSTING SCREW
permits convenient external pressure setting

GUIDE PISTON
has balancing grooves which hydraulically center guide, prevent binding and side-thrust

CONTROL SPRING
is isolated from main flow stream for greatest protection

If you would like a more detailed, close-up look at K & M's new Type 471 External Pilot Pressure Regulator, send for Bulletin 471A.



K&M diaphragm control valves

Our 79th Year

KIELEY & MUELLER, INCORPORATED

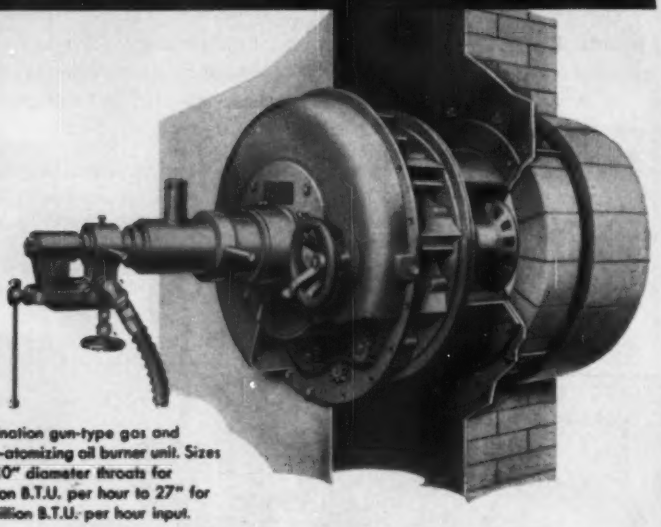
Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

S.A. 1909

For more facts circle 258 on Reader Service card, p 103

ENCO

TYPE E OIL BURNER UNIT



Combination gun-type gas and steam-atomizing oil burner unit. Sizes from 10" diameter throats for 7 million B.T.U. per hour to 27" for 100 million B.T.U. per hour input.

Saves Money and Troubles IN 5 WAYS

1. Vanes can't stick—Easily adjusted

Air register vanes are easily adjusted by a single hand wheel for either clockwise or counter-clockwise air rotation. The action is without stiffness or sticking. Vane shafts are stainless steel — heat-resistant, corrosion-proof — turn smoothly in carbon graphite bearings at all operating temperatures.

2. Positive Vane Control —no lost motion

Chain-and-sprocket air-vane control, with take-up adjustments, assures easy and precise setting at all times. There are no links to wear and wobble with a flopping action of the vanes when they pass dead center.

3. Adaptable to oil or gas —or both

Changeover from oil to gas or a combination of both can be done easily — with comparatively low cost standardized parts—to get the full advantage of variations in fuel prices.

4. For wide range or standard range burners

Registers accommodate standard range or wide range oil burners — mechanical or steam atomizing — and gun type or ring type gas burners—the one best type or combination for your individual needs.

5. Adaptable to all housing designs

Extra deep burner housing can be used to suit practically any fan and any duct arrangement — with lowest installation cost — and provide proper air distribution for efficient combustion.

Bulletin G59 gladly sent on request

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

Free literature

Begins on page 103A

170 **Spec sheet** covers firm's line of inshot and upshot venturi burners with Btu range from 5000 to 400,000 depending on application. Barber Manufacturing Company

PRIME MOVERS

171 **Diesel-engine-powered** electric plants are detailed in 8-p booklet. Kohler Company

172 **Single-stage** mechanical-drive turbine, center-line mounted to minimize shaft misalignment for requirements to 1000 hp, inlet pressures to 875 psig, is featured in bulletin 2001. Dean Hill Corp

VALVES, PIPING FITTINGS AND SPECIALTIES

173 **All-plastic pneumatic valve** is described in 4-p booklet. Features, application info, construction details are given. Illinois Water Treatment Company

174 **Pneumatically-actuated valves,** firm's complete line, are covered in 8-p booklet HB-7. Construction details, operating characteristics, specs aid selection. Conoflow Corporation

175 **Sliding-gate pressure regulators** are topic of 2-p bulletin JNP-5. OPW-Jordan Corporation

176 **All-purpose angle valve** is covered in spec sheet. Jerguson Gage & Valve Co

177 **Air-operated vacuum gate valves** are featured in data sheet V-6. Vacuum Research Company

178 **Supports for piping** and equipment are covered in 96-p book. Firm's system for piping- and equipment-support problems is outlined. Well illustrated with photos, drawings and tables, book also gives details on constant-support hangers and many others. Bergen Pipesupport Corp

179 **Nickel tube** is detailed in technical data sheet. Bridgeport Brass Company

180 **Polyethylene tubing** is announced in catalog 4395A11. Parker-Hannifin Corporation

181 **Rubber expansion joints** for pressure, pressure vacuum and vacuum applications are described in 4-p folder. Mercer Rubber Company

WATER TREATMENT

182 **Ion-exchange resins,** nuclear and technical grades, are detailed in

Hall Industrial Water Report

VOLUME 8 MAY 1960 NUMBER 3

394 Δισεκατομμύριον

The Greek word is billion. But you don't have to savvy Greek to know that 394,000,000,000 gallons is a lot of water. U. S. Industry is expected to be using this much each day in 1980.

Some of the water will be used as is. However, a sizable portion will require treatment to make it suitable for use. This might involve clarification, softening, silica removal, alkalinity adjustment, demineralization, or chemical conditioning to control corrosion or the accumulation of slime. And waste water may have to be treated for disposal or to recover valuable raw materials.

Water problems are Hall Laboratories' business. Experienced Hall engineers are ready to help you plan how to treat your water and how to tackle your water problems.

Excessive Sewer Tax

The size of his sewage bill shocked a manufacturer into the realization that he was contaminating a surface water supply. Waste water was being discharged in part to the municipal sanitary sewage system, in part to a small creek. Discharge to the creek was supposedly nothing but uncontaminated cooling water. However, the municipal authority proved that the water going to the creek was high in suspended solids and oil.

The municipal ordinance required the payment of a surtax if a plant's industrial waste waters contained suspended solids and BOD in excess of normal concentrations in sanitary sewage. Furthermore, plants discharging polluted waters to a surface supply had to pay sewer tax and surtax just as if it were going into the municipal sewers.

A lot of money was involved. Hall Laboratories was retained to determine how the contaminants got into the water going to the creek and how to stop them. After location of the sources, waste waters could be diverted to the sanitary sewage system. The preferred solution, however, was to clean up the waste waters, if this could be done economically. The latter solution would obviate payment of sewer tax and surtax on the water involved.

Hall staff engineer E. G. Paulson worked out procedures for disposing of the industrial wastes which made it possible to drop taxes from $600.00 to $75.00 monthly.

Aluminum Interference in Dyeing

Processing and dyeing of cotton fabrics had almost stopped in a Southern textile mill because of serious trouble in the dyeing operations. Practically all output was unsatisfactory because of migration of dye and deeply colored specks.

Hall industry specialist, Eric Laurin, was given a rush call. He soon established that the difficulty was due to the presence of an excessive amount of aluminum in the clarified and filtered process water.

Inspection of the filter plant showed the settling basins to be old and under capacity for the amount of water required. Floc formation with aluminum sulfate was poor and the water was carrying it out of the settling basins onto and through the filters.

By rearranging baffles in the settling basins and adjusting chemical feed, Laurin was able to improve the condition of the clarified water sufficiently to permit operation. However, floc was still carrying over to the filters and there was continuous danger of further trouble.

The next step was use of a Hagan Coagulant Aid. Results were immediate. Settling of floc in the basins was so rapid that there was practically no carryover to the filters. This was true even with 25% less aluminum sulfate. Several years have now gone by without recurrence of the costly condition.

Calcium Chloride Regeneration

When a dealkalizer in a hospital boiler plant suddenly stopped dealkalizing, Hall field engineer J. Printz received a rush call for help.

The sudden loss of effectiveness led Printz to suspect that the anion exchange material had become coated with something that was acting as a barrier between the water and the resin. Since the raw water seemed normal, his investigations took him almost immediately to the alkaline salt solution used for regeneration. He needed to go no further. One of the operators, to whom brine was brine, had dumped into the sodium chloride brine tank six hundred pounds of calcium chloride intended for preparation of brine for a refrigeration system. When the solution, with some caustic soda added, was used for regeneration of the anion exchanger, enough calcium compounds were precipitated on the exchange material to effectively insulate it from contact with water during operation.

Printz reasoned that if his diagnosis was correct the normal capacity of the dealkalizer should be restored by treatment with a solution of sodium hexametaphosphate (Hagan Phosphate), utilizing the ability of this material to sequester calcium and dissolve many calcium compounds. The procedure worked successfully and the equipment was promptly back in service.

Water is your industry's most important raw material. Use it wisely.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems, write, wire or call address below.

HALL LABORATORIES
HAGAN CENTER, PITTSBURGH 30, PA.
Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

For more facts circle 260 on Reader Service card, p 103

WHAT 7 THINGS HAPPENED RECENTLY AT FRICK COMPANY* IN WAYNESBORO, PENNA.

?

7 important things for FRICK *and you:*

1. First of all, on a foundation of our 107 years' experience, our new management has established a growth policy that stresses new product development, quality control, and expansion of field services.

2. New branch offices are being opened and the sales-engineering staffs of existing branches as well as of the home office are being increased.

3. A compressor of new design is being developed. This, like our current dependable line, will handle a variety of refrigerants such as Freon, ammonia, propane, butane and carbon dioxide.

4. A new circulating system using refrigerated sea water has been introduced to commercial fishing fleets, at a saving to boat owners.

5. Completely insulated Shell-Ice makers have been "packaged" for convenient field installation.

6. Service to the growing poultry industry has been highlighted by our new counter-flow-continuous poultry chiller, which uses refrigerated water instead of ice.

7. As part of the growth policy, we are increasing the number of Frick distributors. Some of our distributors have been with us 50 years.

All of which indicates one thing: Frick is "on the move!" If you're passing through Waynesboro this summer, stop in and see for yourself; you'll be able to enjoy our remodeled and air conditioned offices.

FRICK COMPANY
Waynesboro, Penna.

*Pioneers in depend*ability* since 1853: air conditioning, refrigerating, ice making and quick freezing equipment, power farming machinery and portable sawmills.

Free literature

Begins on page 103A

spec sheet. Illinois Water Treatment Company

183 **Water-cooling systems,** closed-circuit evaporative type, for controlling condensing temperatures, are featured in catalog 35C9c and selection work sheet 35E9c. Recold Corp

184 **Solving an unusual** case of carryover is topic of water-conditioning data sheet. Betz Laboratories, Inc

MISCELLANEOUS

185 **Hydraulic power pumps** for high-pressure applications, hydraulic pipe pushers, cable pullers and allied tools are detailed in 8-p bulletin E-240. Greenlee Tool Co

186 **Progress and achievements** related to engineering art are reviewed in firm's 36-p magazine. Well-illustrated book covers equipment research, engineering findings including atomic-energy projects in both fission and fusion fields. Allis-Chalmers Mfg Company

187 **Screw thread root booklet** includes listing of basic criteria for good thread root, comparative analysis of three widely used thread forms, data on relative performance in tension fatigue, complete specs. Standard Pressed Steel Company

188 **Firm's services dept** for maintenance contracts and emergency repairs on diesels, pipeline pumps and compressors, powerhouse equipment is explained in booklet. National Marine Service, Inc

189 **House organ** discusses valves in industry. This is publication of first volume of house organ. Walworth Company

190 **Tubeaxial blowers** for ventilation of large tanks, other confined areas in topic of data sheet 134. Corpus Engineering Corporation

EDITOR'S NOTE: *The following bulletins may be requested directly from manufacturer. Write on company letterhead to addresses below*

Glossary of wire and cable terms is pocket-sized publication of alphabetical listing of common terms, expressions and units used in the electrical wire and cable industry. Standard Wire and Cable Company, 3440 Overland Avenue, Los Angeles 34, Calif.

continued

any way you look at it...

YARWAY REMOTE LIQUID LEVEL INDICATOR GIVES BRIGHT, INSTANT, ACCURATE READINGS

On its brilliant "wide vision" dial you can clearly read the level from any point in a 180° arc—and from a considerable distance.

Remote readings of levels in boilers, feed water heaters and other heat exchangers are instant and accurate because indicator operating mechanism is actuated by the varying head of the liquid itself, yet the pointer mechanism is never under pressure.

Yarway Indicators may be arranged to operate remote Yarway Electronic Secondary Indicators or remote Hi-Lo Alarm Signals (lights or horns) located anywhere in the plant.

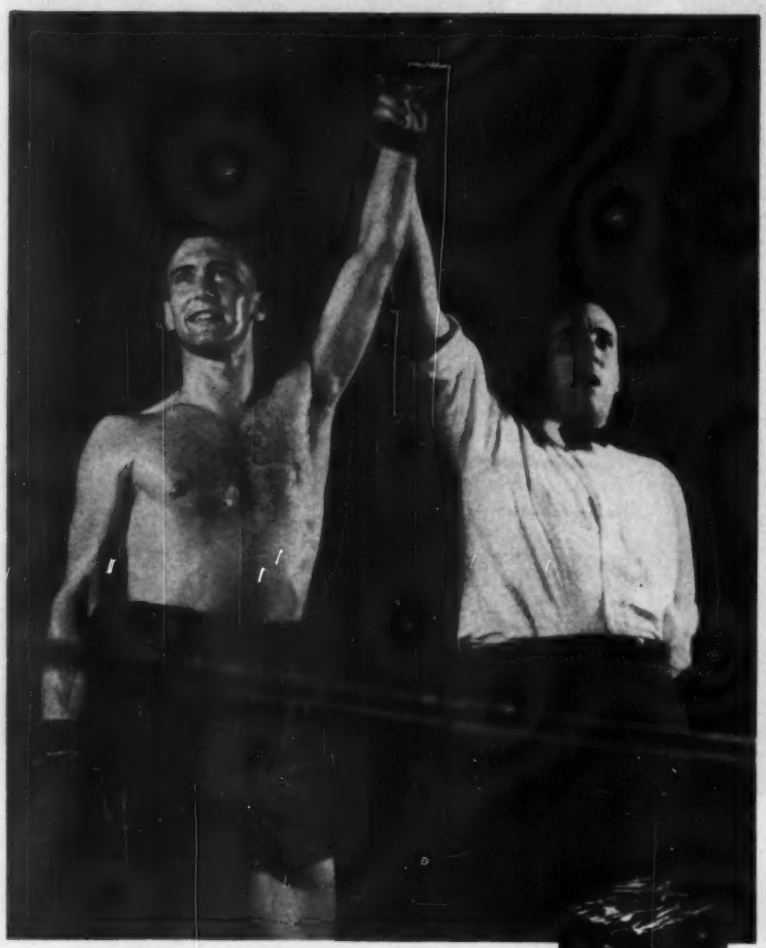
A record of nearly 13,000 successful installations speaks for itself.

For details on construction, operation, installation and typical hook-ups, write for Yarway Bulletin RI-1825.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

IT'S *the decision* THAT COUNTS



...with a fuel, too!

B&O bituminous merits your winning decision for sensible plant operating reasons. (1) Volume supply in wide variety is a sure bet to outlast current competitive fuels. (2) Sources are nearest to major consumption—always dependable. (3) Mining and burning developments continually tailor bituminous to greater efficiency. Bet on B&O Bituminous! ***Ask our man!***

CONSULT COAL TRAFFIC DEPARTMENT, B & O RAILROAD
BALTIMORE 1, MD. *Phone:* LExington 9-0400

B&O B&O B&O B&O B&O

BALTIMORE & OHIO RAILROAD
BITUMINOUS COALS FOR EVERY PURPOSE

Free literature

Begins on page 103A

Advance design and construction features of large steam-turbine-generating units are featured in 40-p book 03B9448. Engineering, development and manufacturing facilities which make units possible are described. Allis-Chalmers Mfg Company, Milwaukee 1, Wis.

Basic guide to ferrous metallurgy, plastic laminated, plaque mounted, is available at price of *$5.00* each. Guide includes carbon-iron diagram showing important working zones, change in grain size with temperature, definitions of metallurgical terms. Tempil Corporation, 132 W 22nd St, New York 11, N. Y.

Industry's battle with fuel ash Large demand for this 6-p *TD* report from April POWER has necessitated puting it back on press. Copies are presently available at 10c each. To order, just send post card telling us quantity you need.

$1,600,000 is cost of three gas turbines for gas-pipeline pumping stations in order given to Italy by U.S.S.R.

Societe d'Exploitation d'Usines Metallurgiques of Corbehem (Pas-de-Calais, France) will manufacture steam-generating equipment for Riley Stoker Corp in France, Spain, Portugal and their possessions.

Red Cross lists seven steps for artificial respiration by mouth-to-mouth breathing: (1) clear victim's throat (2) tilt head back to open air passage (3) hold jaw in jutting-out position (4) pinch nostrils to prevent air leakage (5) blow into mouth until chest rises (6) remove mouth and listen for air return from victim's lungs (7) repeat about 12 times a minute.

SEAMLESS

- Long radius or short—the finest ells ever made . . . hot coined for dimensional accuracy from end to end
- Forged at controlled heat for superior metallurgical quality
- Specially machined ends for quickest fit-up and welding
- Ells, tees, returns—all types of fittings—available in seamless through 24"
- Produced by newest, most modern equipment, combined with latest technology in forging, sizing, heat-treating and machining

Now... Midwest makes BOTH!

WELDED

Formed from plate and welded—fully reinforced . . . same high quality as always.

Especially suited for Long Tangent bonus elbows, reducing ells, and special fittings of unusual shapes

Stocked in carbon steel, wrot iron, chrome-moly . . . available in Hi-Yield and all other weldable metals

Wall thicknesses up to 4"—or more

Delivery from stock—with or without Long Tangents—in all sizes through 36"; to order, through 48"

The world's most complete line of welding fittings... for maximum flexibility in piping design

SOLD THROUGH STOCKING DISTRIBUTORS FROM COAST TO COAST

MIDW

PIPING COMPANY, INC.
1450 SOUTH SECOND STREET
ST. LOUIS 4, MISSOURI

For more facts circle 264 on Reader Service card, p 103 -

US RUBBER CONVEYOR BELTS

NEW POWER PLANT USES 9 "U.S." CONVEYOR BELTS

Appalachian Power's new Clinch River steam generating plant at Carbo, Va. (started operating September, 1958) uses 9 "U. S." belts in its conveyor system for top automation and economy.

Following the shakeout operation, the coal is conveyed from the hoppers by two U. S. Giant® Feeder Belts (20', 48", 4-ply, 48 oz.). Receiving the feed is a U. S. Giant belt (490', 36", 4-ply, SN cotton-nylon) having a lift of 81 feet. Six other "U. S." belts are used in the system, designed to convey 1,200,000 tons of coal a year.

The U. S. Rubber "Coordinated Engineering" method of providing the right belt for the materials to be conveyed helps explain why "U. S." is the world's largest producer of belts—and explains why "U. S." Belts last longer, save you dollars. "U. S." engineers work with the manufacturers of the conveying mechanism and engineers of the plant, to insure you unfailing dependability.

• • •

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

US RUBBER

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

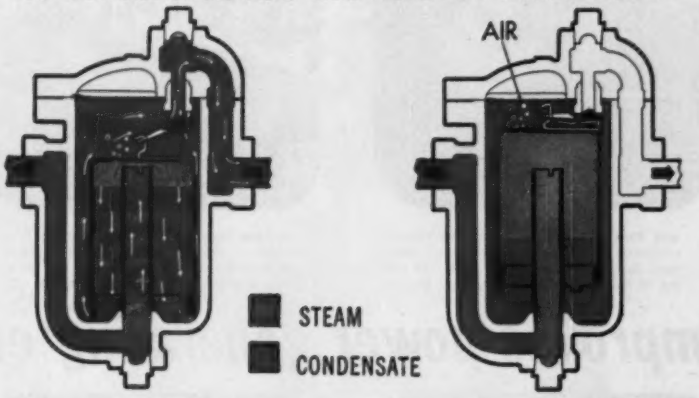
By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

Armstrong Machine Works
8125 Maple Street
Three Rivers, Michigan

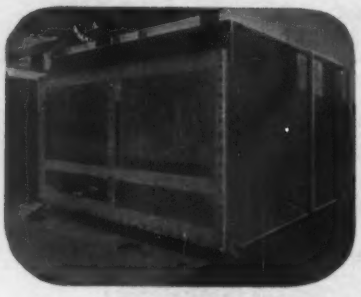
ARMSTRONG STEAM TRAPS

See our Catalog in Sweet's Plant Engineering File

For more facts circle 266 on Reader Service card, p 103

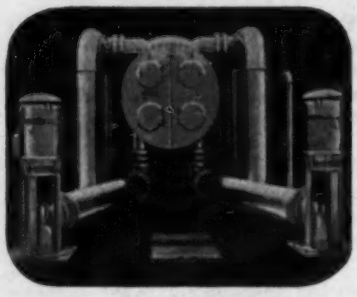
and auxiliary equipment

HOW C.H. WHEELER CONDENSER DESIGN saves space...



Head Room problems are solved by compact condensers like this one. Turbine floor to basement floor, in this case, is only 20 ft. The Unit has 65,000 square feet of condensing surface.

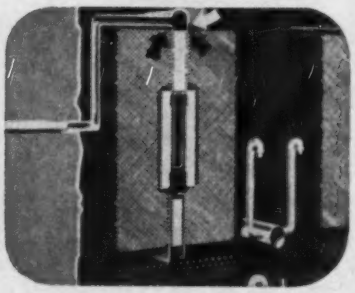
Rectangular Cross Section makes C.H. Wheeler Condensers adaptable to nearly any space or condenser arrangement because the length, width and height of any Wheeler Unit can be varied almost at will.



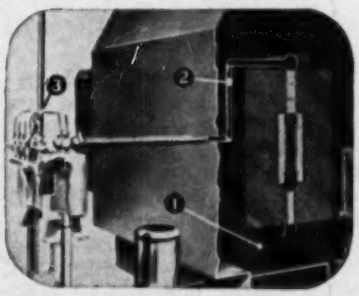
But Wheeler Doesn't limit itself to rectangular design. A round cross section worked out better here, for example, at the first planned gas-steam turbine station ever designed and built in United States.

improves power generating efficiencies...

Triple Lane tube layout, another design feature, provides 3 pathways for steam travel utilizes maximum cooling surface and produces higher condenser vacuums for power generating stations.

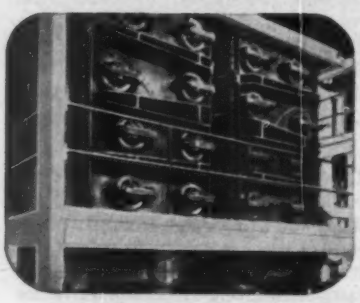


Location of air-vapor takeoff speeds steam travel and allows steam to penetrate to the peripheries of all tubes. It thus improves condenser efficiencies and overall power station operation as well.



Deaeration of condensate not to exceed 0.01 cc. oxygen/liter is available with special Wheeler designs. Note the Deaerating Bars (1), the Air-Vapor Suction Line (2), and Tubejet® Ejectors (3).

and reduces maintenance



Patented Reverse Flow permits flushing tubes and sheets without shutting down Unit, during full load with either or both circulating pumps operating. No additional circulating water inlet or discharge piping necessary with C.H. Wheeler's Reverse Flow.

"Pull-Out" Condensate Pumps simplify maintenance because entire pumping element, including all rotating parts, can be removed without disturbing either the pump barrel or the piping connections.

C. H. Wheeler Circulating Pumps, like Condensate Pumps, are easy to inspect and maintain because of "Pull-Out" design. In addition, shafts are heat treated alloy steel and impellers are statically and dynamically balanced for trouble-free operation.

C. H. Wheeler has been designing and building condensers since 1903; has developed such features as Dual Bank Design and Reverse Flow.

C. H. WHEELER MFG. CO.

19TH & LEHIGH AVENUE
Philadelphia 32, Pennsylvania

Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

For more facts circle 267 on Reader Service card, p 103

CLEANED SAFELY WITH PFIZER CITRIC ACID

STAINLESS STEEL BOILERS, HEAT EXCHANGERS, ATOMIC INSTALLATIONS, CHEMICAL PROCESSING EQUIPMENT CLEANED SAFELY, EFFICIENTLY WITH PFIZER CITRIC ACID

● Industry experience proves that citric acid eliminates chloride stress corrosion problems — provides effective descaling — permits easier, more efficient after-rinsing.

Discuss with your chemical cleaning service company these advantages of Pfizer Citric Acid in stainless steel cleaning solutions:

1 Citric acid is highly efficient in removing imbedded metal and oxide films from stainless steel.

2 Citric acid's excellent sequestering ability prevents reprecipitation of dissolved scale.

3 Citric acid cleaning eliminates the problem of chloride stress corrosion.

4 Citric acid can be effectively inhibited without losing its cleaning or sequestering ability.

5 Citric acid is sold as a dry, 100% acid — meaning savings in storage and handling.

6 Citric acid is water soluble, easy to handle, and non-toxic.

Let us send you further information, cost and obligation-free!

I want to learn more about the use of Pfizer Citric Acid for cleaning stainless steel equipment. Please send me Technical Bulletin 102.

Name_____

Company_____

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City_____ Zone____ State_____

Science for the world's well-being

Manufacturing Chemists for Over a Century — Pfizer

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Branch Offices: Clifton, N. J.; Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Tex., Montreal, Canada

For more facts circle 268 on Reader Service card, p 103

ANNOUNCING A NEW CORPORATE NAME

for The Garlock Packing Company

Garlock Inc. becomes the new name for The Garlock Packing Company, Palmyra, N. Y., to reflect more accurately its broad diversification of products and markets.

Originally established to manufacture mechanical packings, Garlock now produces over 2,000 different styles of packings, gaskets, seals, molded and extruded rubber and plastic products for every major industry.

The new corporate name, Garlock Inc., more closely identifies this 73-year-old company with the growth and development of its product lines. *Today, industry goes to Garlock for such widely diversified products as:*

- Hydraulic-Pneumatic Packings
- Oil and Grease Seals
- Gasketing and Expansion Joints
- Braided Packings
- Molded and Extruded Rubber Parts
- Plastic Stock Shapes and Fabricated Parts
- Mechanical Seals for Rotating Shafts
- Metal Packings
- Leather Packings
- Electronic Components
- Dry Bearing Materials
- Fluorocarbon Tank Linings
- Missile and Rocket Components

To help you in selecting or applying these products, Garlock offers the services of over 126 thoroughly-trained sales engineers, 175 electronic component manufacturers' representatives, 180 authorized bearing distributors and 69 foreign distributors. Conveniently located warehouses and stocking points assure Garlock customers of prompt delivery.

At Garlock Inc., design and development of new or improved products and materials is an ever-present objective. To this end Garlock maintains extensive research and laboratory-test facilities. In addition, Garlock engineers and chemists are always ready to work with you in seeking solutions to tough application problems.

GARLOCK

To find out more about "the new Garlock," call the nearest of our 26 sales offices, or write to Garlock Inc., Palmyra, N. Y. *To assure prompt attention,* please refer to *Garlock Inc.* on all future correspondence and orders.

Canadian Div.: Garlock of Canada Ltd.

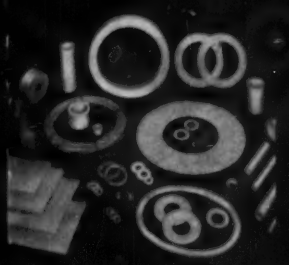
Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

For more facts circle 269 on Reader Service card, p 103

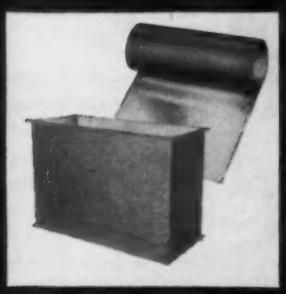
Hydraulic-Pneumatic Packings

Expansion Joints

Molded and Extruded Rubber Parts



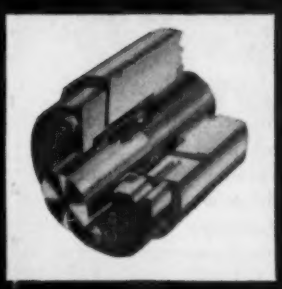
Plastic Stock Shapes and Fabricated Parts



Fluorocarbon Tank Linings

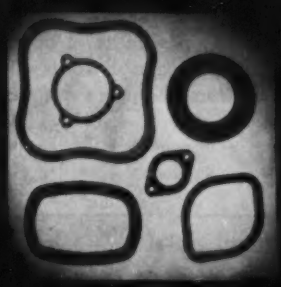
Oil and Grease Seals

Braided Packings

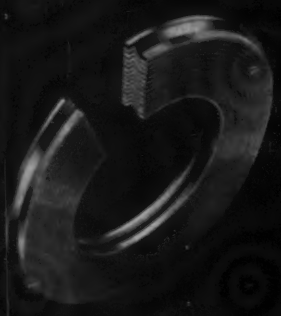


Mechanical Shaft Seals

Metal Packings



Gasketing



Spiral Wound Gaskets

Dry Bearing Material

INC.

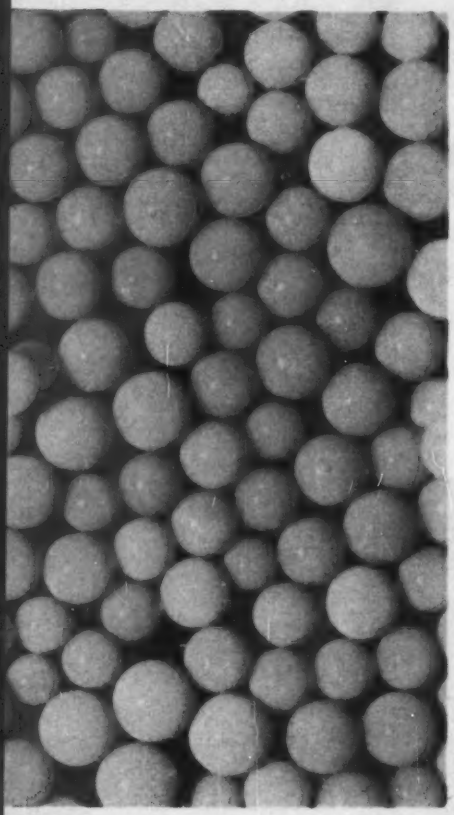
Missile and Rocket Components

Leather Packings

Electronic Components

For more data on these developments, circle key numbers on Reader Service card, p 103

Plant equipment news... Your



Cation-exchange resin keeps whole-bead content

1 • Major advancement in synthesis of cation-exchange resins is a sulfonated styrene-divinylbenzene copolymer with chemical and physical stability built into polymeric structure. Amberlite 200 is characterized by a whole-bead content approaching 100%—few, if any, internal cracks, according to maker. Resins are in moist, sodium form and are characterized by extremely hard, tan, spherical particles.

Operating capacity is somewhat lower than conventional resins, particularly at high flow rates and high regeneration levels. Longer operating life of Amberlite 200 (whole-bead content remained at 100% level after treating 1.6-million gal of water per cu ft of resin) helps compensate for this. Resin may be used in both hydrogen and sodium cycles at temperatures up to at least 250 F. It's suitable as acidic resin component of monobed columns.

Recommended applications of resin: softening water supplies that cause standard resins to decrosslink, hot-lime-zeolite processes, rejuvenation of plating solutions, mixed-bed deionization.

Amberlite 200 is completely stable in hydrogen form and is unaffected by the 2 to 10% acid solutions necessary for regeneration. Stability of this exchanger should minimize any possibility of degradation products forming and fouling following anion exchanger. Resin is said to practically eliminate formation of fines resulting from alternate exposure to dilute water solutions and moderate concentrations of acid.—Rohm & Haas Company

Ultrasonic meter measures flow of liquids through pipeline

2 • Ultrasonic flowmeter employs high-intensity sound waves, transmitted through walls of pipe to flowing liquid, for measuring quantity and rate of flow. Meter is expected to resolve problems of field-testing large water meters and checking flow in pipelines and fire-protection systems already in service.

Transmitter and receiver attach to outside walls of pipe; nothing goes inside pipe. Meter sends an ultrasonic beam across stream and measures shift of beam under flowing liquid's influence. Transducer sounds echo inside pipe and a fraction of it is picked up by detector on opposite wall of pipe. Detector produces small voltage which can be amplified and read on voltmeter. Voltage varies with velocity of flow in pipe; circuits modify voltage according to liquid's density so that both volumetric and mass flow are measured.—Gulton Industries, Inc

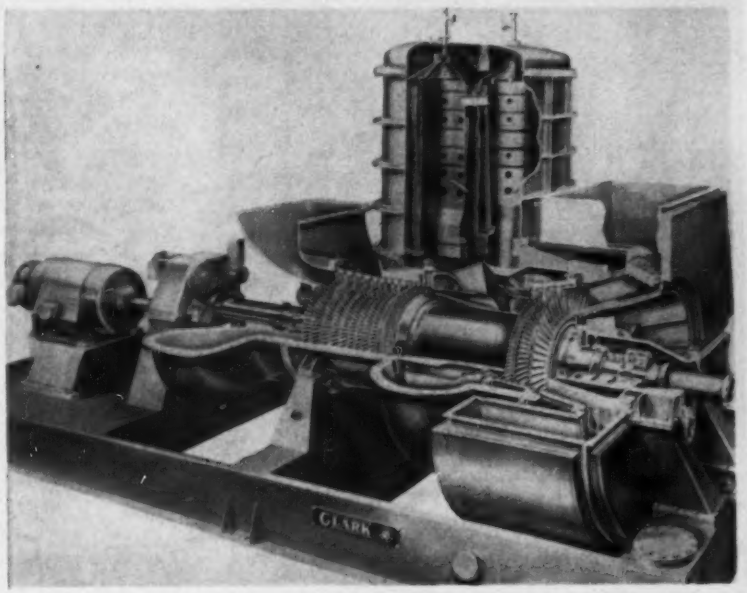
information center for new products and materials

Single-shaft gas turbine rated 9000 bhp

3 • Open-cycle single-shaft gas turbine with a NEMA rating of 9000 bhp is capable of continuous operation under full-load conditions at normal rated speed of 5000 rpm. According to maker, compact unit is designed to achieve savings in equipment cost, transportation, floor space, foundation and installation expense.

Unit is said to insure minimum speed variations under transient load conditions. At rated speed, axial compressor delivers a mass flow of 135 lb per sec. Turbine inlet is held under 1400 F, for a substantial margin of operating safety. Turbine is completely air cooled; optional air-cooled lube-oil cooler permits operation free of water requirements.

The 3-stage turbine has rotor of builtup forged-steel-disk design. Renewable labyrinth strips are provided at all close-clearance points on turbine shaft to minimize leakage. Bearing supports are split on the horizontal center line, permitting inspection or replacement without having to remove rotor. Lagged insulation on gas-turbine exhaust minimizes heat radiation and provides operator safety. Unit burns either liquid or gaseous fuels.—Clark Bros Company



Evaporator collects, measures water for purity testing

4 • Continuous water-sample evaporator automatically collects, records and measures the weight of as many as one million separate samples in a single, final sample of any desired concentration. Design feature is sample-carrier assembly which continuously protects sample from contamination. Inlet-water and heater controls interlock to prevent water sample from boiling. Manually set timer control is provided for concentrating final sample to a minimum desirable volume. — Diamond Power Specialty Corp, Electronics Div

Brass fitting for plastic tube never needs tightening

5 • Brass fitting designed specifically for plastic tubing gives complete retention on polyethylene, nylon and other plastics. According to maker, fitting never needs retightening even when subjected to high vibration and internal pressure. Insert-collet locking action of design is said to eliminate pulling out of fittings due to cold flow. Brass insert in one end of tubing holds tube firmly and prevents collapsing. Fittings can also be used with copper, steel and aluminum tubing. — Commonwealth Brass Corporation

Control valves for high pressures and pressure drops

6 • Single-seated control valves are engineered to meet modern power-plant applications, says maker. Features include high capacity, ability to handle high pressures and pressure drops and a wide selection of reduced-capacity trim. Design incorporates top-guided unrestricted seat-ring area with body and plug contours for greater capacity. Minimum seat-ring areas result in less unbalance force, permitting higher pressure drops. Selection of materials will meet all operating conditions.—Worthington Corp, Mason-Neilan Div

For more data on these developments, circle key numbers on Reader Service card, p 103

More **equipment news**

For more data on these developments, circle key numbers on Reader Service card, p 103

Nylon tubular bars available for bearings

7 • Reduced manufacturing costs make possible a 50% price reduction for tubular bars of MC-nylon formulation. Recommended for use as lubricated sleeve bearings at pressure velocity values up to 50,000 in continuous service, 5000 pressure velocity as unlubricated bearings, material is said to provide improved resistance to deformation under load. Lightly crosslinked, it should provide improved wear characteristics and better dimensional stability, according to maker. Total load-bearing capacity is limited to 500 to 1500 psi of projected area, depending on specific use.

Tubular bars will be available in outside diameters ranging from 2 to 15 in., wall thicknesses of ⅜, ½, ¾ and 1 in. Larger sizes can be made to order. Material will be supplied in blue color to distinguish it from other nylon formulations. Stock should find use for gears, seals, valve seats, other applications.—Polymer Corporation

Breaker ends need for panel increases

8 • New circuit breaker lets you increase number of circuits without having to increase size of panel, says maker. With installation of breaker, a regular 8-circuit panel will accommodate eight lighting or general-purpose circuits plus main double-pole breaker and a double-pole range breaker. Unit will fit any control panel.

Breaker has two separate protective elements—a coil type solenoid and a thermal bimetal. Bimetal provides built-in time delay which prevents nuisance tripping for nondangerous overloads. High overloads or shorts set up a magnetic field in the solenoid which instantly releases latch and opens the circuit. Units operate both manually and automatically.—I-T-E Circuit Breaker Company, Bulldog Electric Products Div

Compactness, efficiency mark speed control

9 • Dc-motor speed control features greater efficiency over full speed range, higher performance reliability, according to maker. Control presently rated for dc shunt motors up to five hp can be adapted for dc motors of larger sizes. Maker says control assures constant speed regardless of load variation. There are no moving parts.

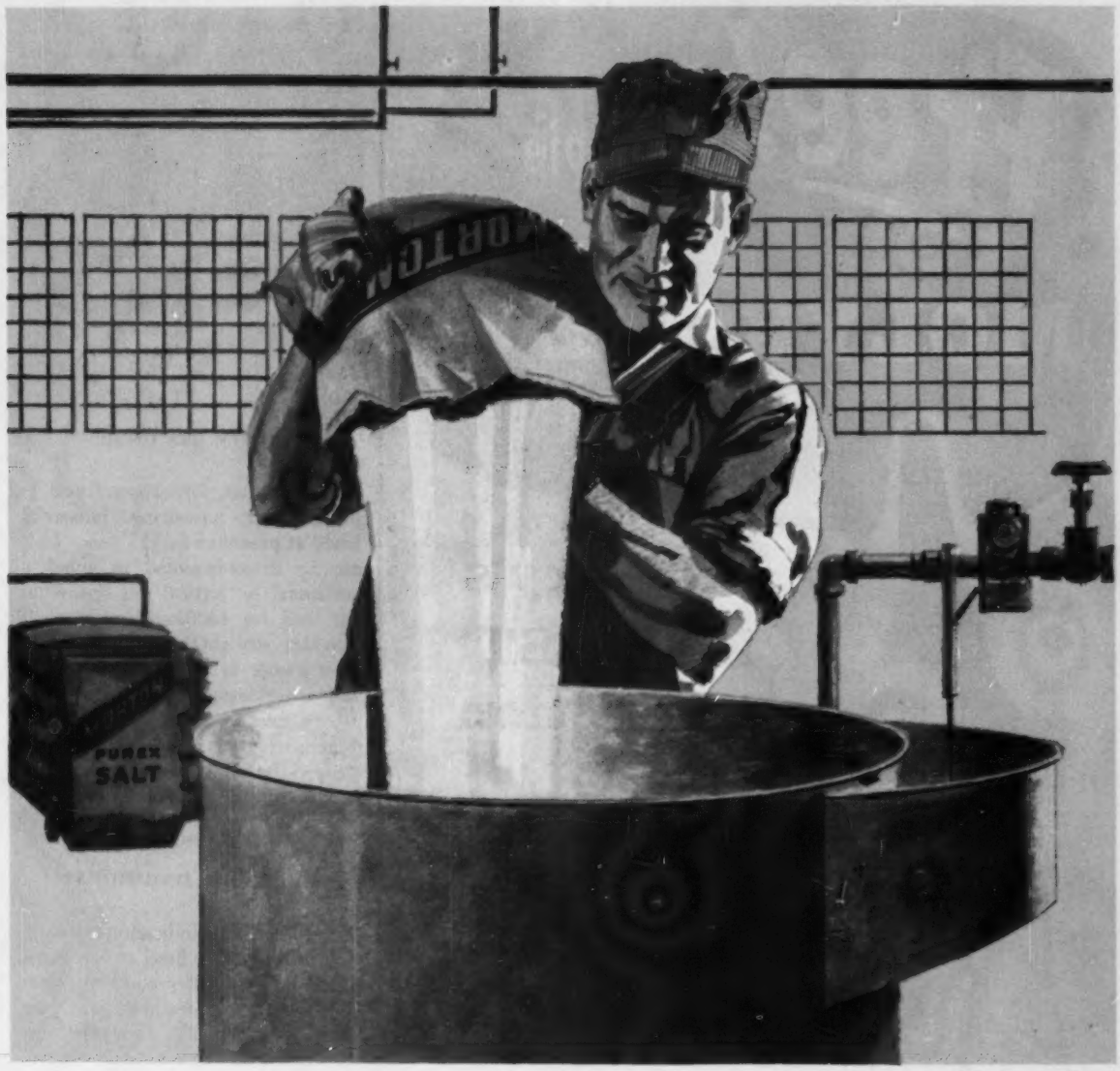
Power for control can be obtained from any ac outlet. Unit has reduced weight and size, low voltage drop. Dials permit precise, stepless control. Construction is rugged but allows simple installation. Significant components are silicon-controlled rectifiers and magnetic triggers. Components will provide long reliable life span, says maker. No warmup time is required.—ACF Industries, Incorporated, ACF Electronics Div

Brushless drives are versatile, compact

10 • Adjustable ac speed drives have integral-unit construction, are rated ¼ to 100 hp. Larger drives with bedplate-mounted motor are offered up to 700-hp liquid cooled. Simple control modifications will provide variety of speed operating functions.

Drive supplies power to conveyors, fans and pumps, winders—any application where speed control is needed. There are no brushes, commutators or slip rings to maintain.—Westinghouse Electric Corporation

For more data on these developments, circle key numbers on Reader Service card, p 103



This brine tank never needs cleaning out

With 100% soluble Morton Purex Salt you never have an accumulation of insolubles: no encrustation, no sediment buildup in brine storage chambers. For Purex Salt is guaranteed to have both a minimum purity of 99.5% sodium chloride and to be free of insoluble matter than can settle out in brinemaking systems. You'll find Purex ideal for producing a fully saturated, high clarity brine at highest possible flow rates.

Produced in the economical vacuum pan system, Morton Purex Salt has a controlled granulation best suited for automatic brinemaking and brine storage installations. It dissolves rapidly and uniformly, giving particularly fast flow rates of saturated brine where the water flows through a salt bed, as in automatic brinemaking units.

Available in bags and bulk carloads, Purex can be used in bulk wet storage systems and in Morton Model E Series Brinemakers.

For more information about Morton Purex Salt and for free expert help on any water softening or brinemaking problem, write or wire:

Beat Heat Fatigue by taking Morton Yellow Salt Tablets. They give fast relief without causing nausea or stomach upset. Available with heavy duty disposable dispensers.

MORTON SALT COMPANY

INDUSTRIAL DIVISION

Dept. P-5, 110 No. Wacker Drive, Chicago 6, Illinois

For more facts circle 270 on Reader Service card, p 103

Free! Sample Tube of MOLYKOTE® G LUBRICANT

Industry's NEWEST Production TOOL

- ALMOST 100% SAFETY AGAINST GALLING AND SEIZING WITH ALL BEARING METAL COMBINATIONS
- ELIMINATES STICK-SLIP, METAL PICK-UP AND DISTORTION IN PRESS FITTING
- REDUCES WEAR-IN TIME AND DAMAGE IN NEW OR REBUILT MACHINERY
- THE HIGHER THE LOADS, THE GREATER THE MARGIN OF SUPERIORITY OF MOLYKOTE G

Write for your free sample of MOLYKOTE G LUBRICANT today. We will also send you a copy of our new Bulletin 126 which gives complete details. THE ALPHA-MOLYKOTE CORPORATION, 65 Harvard Avenue, Stamford, Conn. Phone Fireside 8-3724. Plants in Stamford, Conn., Munich, Germany and Strasbourg, France.

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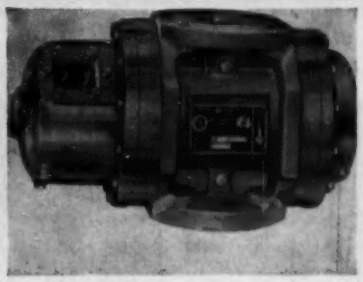
MOLYKOTE G
LUBRICANT

Equipment news

Begins on page 122



Rotary gas meter

28 • Compact, low-capacity unit is suitable for measuring industrial loads at pressures to 125 psig. Unit can be flange-mounted in either a horizontal or vertical gas line without need for additional support. It provides straight-through gas flow. Flow range to 3000 cfh combined with a working-pressure rating of 125 psig is intended to adapt this meter to measurement of many industrial loads.—Dresser Industries Inc, Roots-Connersville Blower Div

Indicating transmitter

35 • Pneumatic indicating transmitters for pressure, flow, temperature, liquid level, differential pressure and dew point feature measuring elements specifically designed for each major process variable. Instrument components are enclosed in a weatherproof steel case with corrosion-resistant vinyl-coated gasketed door.—The Foxboro Company

Just circle key numbers on the Reader Service Card, page 103, to get complete product story

Pressure gage

34 • Heavy-duty geared-movement pressure gage is designed for wide range of applications, says maker. Recommended for oil, water, steam, gas or any other media not corrosive to brass or bronze, unit is said to eliminate inaccuracies in pressure readings resulting from any distortion of piping. You can install it by hand-turning the gage case. Unit comes with heavy-duty drawn-steel

For more facts circle 271 on Reader Service card, p 103

circle 272 on Reader Service card, p 103 ▶

STEAM THE MODERN WAY

In Less Space, At Less Cost

CLAYTON STEAM GENERATORS...

SAVE SPACE AND INSTALLATION COSTS—Only a fraction the size and weight of ordinary boilers. Models from 16½ to 175 HP. All sizes 65 to 195 psi. Larger sizes 15-295 psi.

SAVE ON STEAM—You pay only for the steam you use. Steam in 3 minutes or less from cold start—no standby loss.

SAVE ON OPERATING COSTS—Cut fuel costs up to 50%, save labor, maintenance and time.

Write today for more complete information.

Clayton

416 MANUFACTURING COMPANY

EL MONTE, CALIFORNIA • CINCINNATI, OHIO

Here's why you're money ahead

with A. O. Smith glass-protected smokestacks

- Now available in a variety of colors
- They last longer — as much as 3 to 5 times longer than unlined steel stacks — corrosion resistant regardless of excess condensate
- Glass is tough, durable — shows remarkable resistance to impact or abrasion
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Write Dept. P-50 for full facts.

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For more facts circle 273 on Reader Service card, p 103

NEW HIDDEN WEAPON FIGHTS PUMP LEAKAGE

Long ago, Blackmer solved the problem of shaft leakage with a special seal designed exclusively for Blackmer pumps. Now, for complete leakage protection, Blackmer adds a new O-Ring seal which prevents head leakage as well. The results—cleaner plants, less waste, better performance under pressure—are just a few good reasons you should specify Blackmer rotary pumps. There are many more. Write for Bulletin One.

"liquid materials handling"® equipment

BLACKMER / rotary pumps

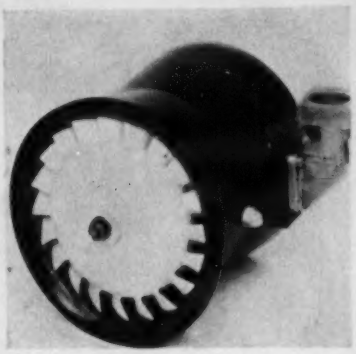
BLACKMER PUMP COMPANY, GRAND RAPIDS 9, MICHIGAN
Find your Blackmer Man under "Pumps" in the Yellow Pages

For more facts circle 274 on Reader Service card, p 103

Equipment news

Begins on page 122

case, friction type snap-on ring beaded for lens protection.—American Chain and Cable Company, Helicoid Gage Div



Axial-flow blower

37 • Designed like a turbine, blower develops high pressure—up to 25-in. H_2O from a 4-in.-dia axial-flow rotor. Unit size can be cut in half in some applications, maker states.

Design uses thin, highly curved blades. Reduced blade height along air passages helps control pressure gradients. Unit shown is 28-v dc; also available are 12-v dc and 110-v 60-c drives, 400-c motors.—General Turbine Corporation

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Antiseize, lube compounds

24 • Three compounds are available. One prevents seizing and galling regardless of applied load on threaded parts at temperatures up to 2100 F. It reduces takeup torque and won't drip off red-hot surfaces, according to maker.

Antiseize and sealing compound can be used on titanium, stainless steel, steel, aluminum and h-t alloys at temperatures up to 400 F. A high-purity version, said to be impervious to moisture, high voltage and cyclic thermal stress, is designed to prevent product contamination.— Crawford Fitting Company

continued

New Economy in a New ANCHOR PRODUCT

Smooth, Black ANKORITE 1000

Ankorite 1000 is an Underwriter's approved electrical insulating tape with all the important qualities of the more expensive tapes. For example, resistance to acids, alkalies, corrosive salts, oil, grease and water is excellent. It resists abrasion, remains flexible, and is unaffected by sunlight. Here are other specifications of this versatile tape:

Dielectric Strength	1000 volts/mil
Insulation Resistance	10^6 Megohms
Tensile Strength	26 lbs/in. width
Elongation	200%
Temperature Range	32°-175°F.

Take advantage of the savings offered by new Ankorite Electrical Tape NO. 1000. For full details, see your Anchor Representative, or contact the Anchor General Office in Philadelphia, today.

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FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

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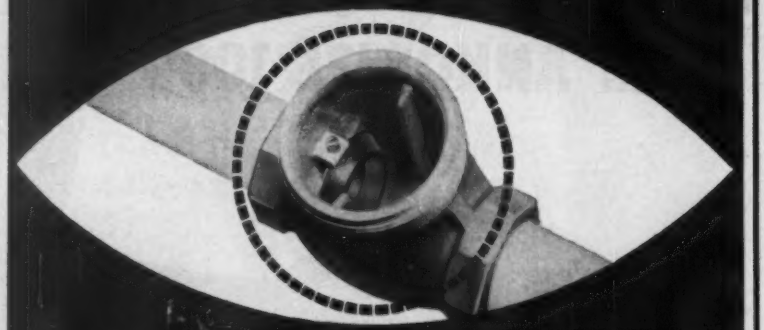
NO OTHER VALVE IN THE WORLD
LOOKS LIKE THIS
WHEN YOU REMOVE THE BONNET



FAIRBANKS® RENEWABLE
SEAT RING GATE VALVE

Never has to be removed from the line to replace the seat rings. For the first time in valve history, you can replace the seat rings in a renewable seat ring gate valve, under all normal conditions, in less than 10 minutes, using just a screw-driver, and *with the valve body still installed in the line.* It is simply a matter of removing the bonnet (easily accomplished with the Fairbanks two piece union bonnet construction) loosen the stainless steel retaining screws and lift out the monel seat rings from the body. The new seat rings slip into place and are positively secured again with the retaining screws.

Fairbanks new 200 pound steam working pressure gate valves, available in sizes ½" through 2" in the rising and non-rising stem construction, have been field tested for over two years under all conditions from steam to corrosive liquids and have proven completely satisfactory—absolutely dependable. Seat rings have been replaced in from 7 to 10 minutes from the time steam was shut off until it was turned on again. In several instances, it was reported that the replacement was performed in just 4 minutes.

This new patented valve design is typical of the sound engineering and outstanding values found in Fairbanks complete line of Bronze and Iron Body Valves.

YOURS ON REQUEST: Illustrated, descriptive folder gives complete information on Fairbanks Renewable Seat Ring Gate Valve, with details and specifications. Yours without charge. Write today.

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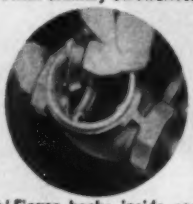
Valves • Trucks • Casters • Wheels • Dart & "PIC" Unions

1 Retaining screw loosened with ordinary screwdriver.



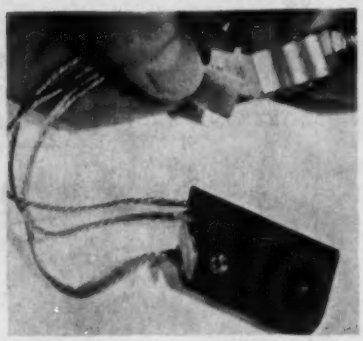
2 Finger hooks inside seat ring. Seat ring lifted out of valve body.

3 New seat ring is inserted. Retaining screw tightened.

4 Bonnet replaced on valve body.

Equipment news

Begins on page 122



Quick-disconnect terminal

26 • Electric-utility equipment or any motor or generator with hard-to-reach brushes can now be serviced easily, maker states. New quick-disconnect terminal assembly facilitates brush replacement. A stationary clip is bolted to machine, and one or two terminals simply snapped in. All parts are silver-plated beryllium copper for minimum resistance.—National Carbon Company

All-plastic bearing

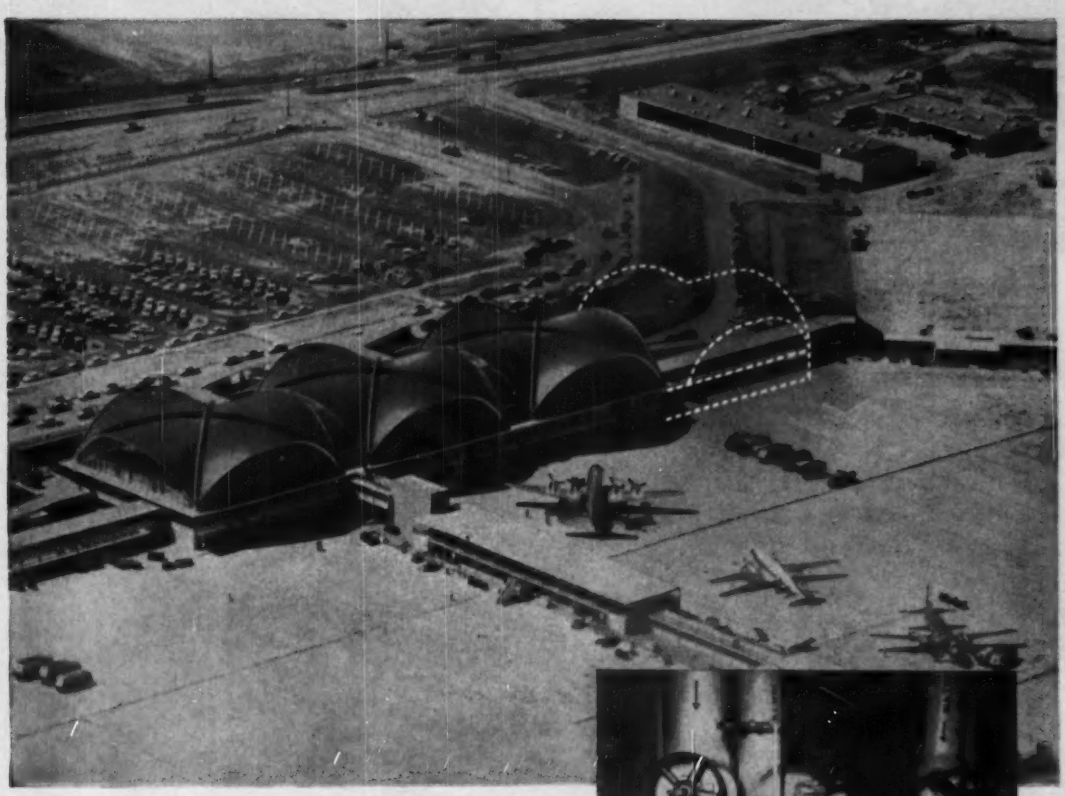
20 • All-plastic bearing can be run dry, doesn't need lubricant, says maker. Low coefficient of friction of the bearing surface plus inherent ability of material to withstand frictional heat should result in reduced maintenance and lubrication cost, cut danger of bearing failure and machine downtime.—Industrial Safety Supply Co, Inc, Industrial Plastic Supply Div

Just circle key numbers on the Reader Service Card, page 103, to get complete product story

Control, telemetering system

33 • Binary digital high-speed supervisory and telemetering system has capacities up to 2048 points. Transmission speed is adjustable and system-error-monitoring features are included. Power supply for master and slave station ends of system can be from station-battery or 115-v ac 60-cycle single-phase supply.—Industrial Process Engineers

continued



Nalco protects vital services of new

LAMBERT-ST. LOUIS AIRPORT

Functional efficiency is usually one of the hallmarks of fine architecture and it is apparent throughout the new St. Louis Municipal Airport Terminal Buildings.

Vital service facilities are housed in a low, clean-lined power plant, well separated from the present main terminal building in anticipation of planned expansion to accommodate increasing airline traffic. The Nalco System protects boiler and cooling water systems by effectively controlling scale, corrosion and microbiological growth . . . a non-architectural supplement to functional efficiency in *any* plant where water is used.

Whether you are planning a new plant, or modernizing an old one, call on Nalco for water treatment chemicals and services that consistently produce outstanding results.

Top photo: Unusual modern architecture of St. Louis Municipal Airport Terminal Building is expandable in any direction. New units (dotted lines), can be added readily when required. Services buildings, upper right, are built and equipped with future expansion in mind. *Photo by Lloyd Spainhower.*

Lower photo: Nalco Chemicals and Services protect both boiler and cooling water systems at new St. Louis Airport. In this photo a Nalco cooling water treatment, supplied in ball briquette form, is being applied through the convenient Nalco feeder.

National Aluminate Corporation is now

NALCO CHEMICAL COMPANY

6222 West 66th Place • Chicago 38, Illinois

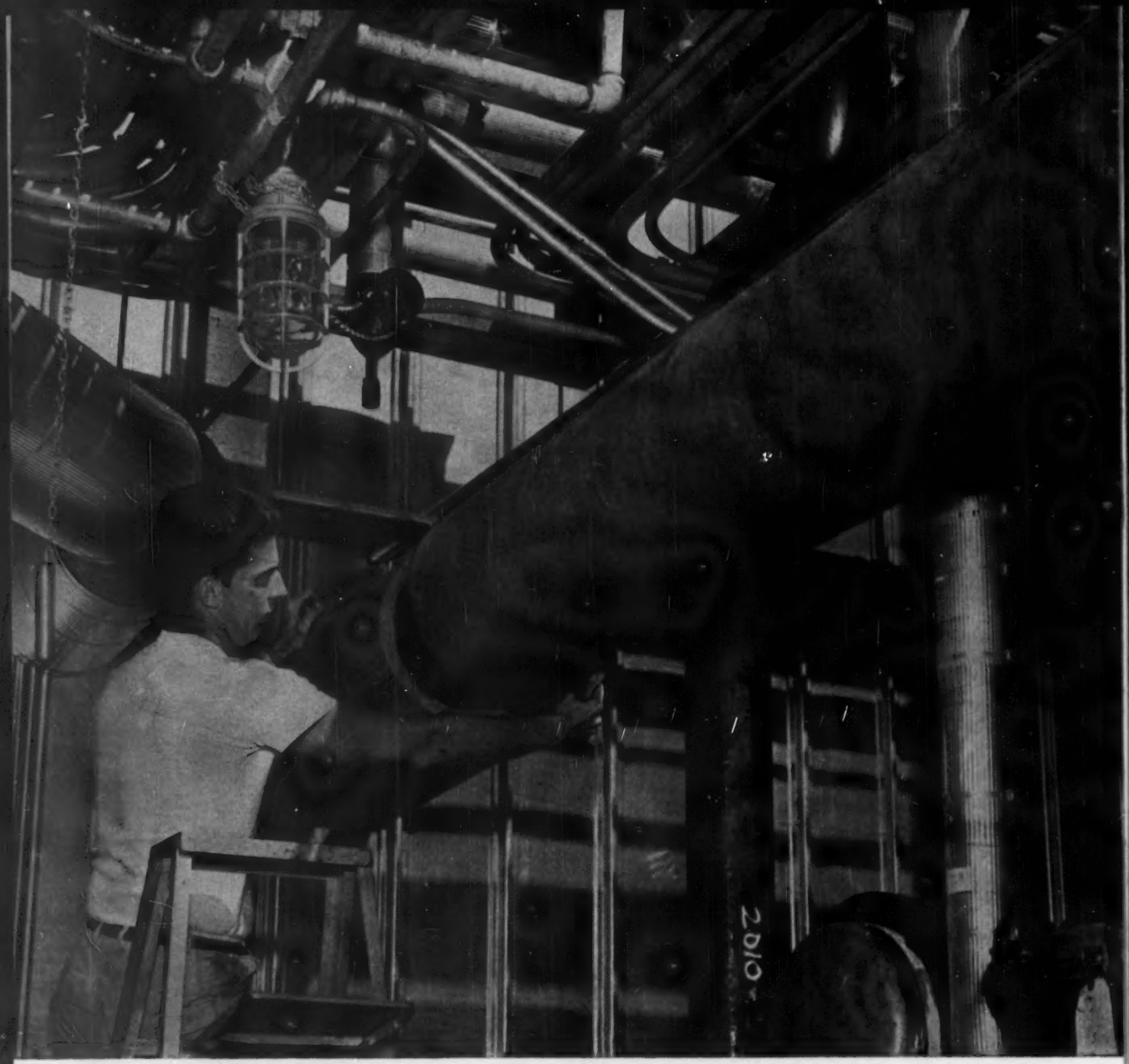
Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany

In Canada—Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM . . . *Serving Industry through Practical Applied Science*

Nalco CHEMICALS

For more facts circle 277 on Reader Service card, p 103



"Piping hot!" ... but easy to insulate with G-B SNAP*ON®!

No need to shut down hot lines when you insulate—not when you use G-B Snap*On, the original one-piece pipe insulation molded of fine glass fibers. It's so easy to apply that you can snap it over a 350° line (shown above) in one easy motion, without risk. Whether you apply it on straight runs, in close, crowded quarters, or under special conditions where workmen must consider their safety, you save all kinds of time with G-B Snap*On.

Thermal efficiency? There's absolutely *nothing* better in general-purpose pipe insulations; in fact, 1½" G-B Snap*On is the thermal equivalent of most 2" insulations! It's also permanent—and reusable. For your next job involving chilled lines or piping up to 350° F., indoors or out, get G-B Snap*On—"the best there is." It's available locally in sizes from copper tubing to 36" IPS—plain, or with the appropriate vapor barrier or weatherproof jacket.

FOR INFORMATION & PROMPT DELIVERY SEE YOUR G-B SNAP*ON DISTRIBUTOR (LISTED IN ADJOINING COLUMN)

GUSTIN-BACON *Manufacturing Co*

GUSTIN gb BACON

242 W. 10th ST., KANSAS CITY, MO.

Thermal and acoustical glass fiber insulations . . . molded glass-fiber pipe insulation
Couplings and fittings for plain and grooved end pipe

G-B SNAP*ON DISTRIBUTORS

LISTED IN YELLOW PAGES

(See ad on facing page)

AKRON, Ohio, The Asbestos Supply Co.
ALBANY, Ga., Industry Insulation Co.
ALBANY, N. Y., Hudson Valley Asbestos Corp.
ALBUQUERQUE, N. M., Mt. States Insulation Co.
AMARILLO, Tex., McDonald Engineering & Insulating Co.
ATLANTA, Ga., Reynolds Aluminum Supply Co.
AUSTIN, Tex., Cinbar Engineering Co.
BALTIMORE, Md., Leroy Insulation Co.
BANGOR, Me., Eastern Glass Co.
BATON ROUGE, La., Eagle Asbestos & Pkg. Co.
BEAUMONT, Tex., Solar Supply Co.
BILLINGS, Mont., Big Horn Supply, Inc.
BIRMINGHAM, Ala., Reynolds Aluminum Supply Co.
Shook & Fletcher Supply Co.
BORGER, Tex., Western Chemical Co.
BOSTON, Mass., Homans-Kohler, Inc.
BUFFALO, N. Y., Industrial Insulation Sales, Inc
CHAMPAGNE, Ill., Lewie David Co.
CHARLESTON, W. Va., Asbestos & Insulating Co.
CHARLOTTE, N. C., D&B Insulation Co.
CHICAGO, Ill., E. C. Carlson Co.
Culberg Asbestos & Cork Co.
CHILLICOTHE, Ohio, Southern Ohio Insulating Co.
CINCINNATI, Ohio, R. E. Kramig Co.
CLEVELAND, Ohio, Ohio Asbestos & Insulation Co.
COLUMBIA, S. C., Industrial Insulation Div. of Richland Oil Co.
COLUMBUS, Ohio, Santeler Brothers
Culberg of Ohio
CORPUS CHRISTI, Tex., Precision Insulation Co.
DALLAS, Texas, Acme Insulation & Supply Co.
DAVENPORT, Iowa, Republic Electric Co.
DAYTONA BEACH, Fla., B & F Insulation Co.
DENVER, Colo., Gene Wright Lumber Co.
Powers Industrial Insulation, Inc.
DES MOINES, Iowa, Iowa Asbestos Company, Inc.
DETROIT, Mich., The Walter Rankin Co.
ERIE, Pa., Laco-McMullen Co.
EVANSVILLE, Ind., George Koch Sons, Inc.
FALCONER, N. Y., Laco Roofing
FT. SMITH, Ark., Gunn Distributing Co.
FT. WAYNE, Ind., M. H. Hilt, Inc.
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GREENSBORO, N. C., Starr Davis Co., Inc.
GULFPORT, Miss., Paine Supply Co.
HOUSTON, Tex., Precision Insulation Co.
INDIANAPOLIS, Ind., Lyon Lumber & Supply Co.
JACKSON, Miss., Paine Refrigeration & Supply Co.
JACKSONVILLE, Fla., Eccles Distributors, Inc.
Reynolds Alum. Sup. Co.
JOPLIN, Mo., Joplin Cement Co.
KANSAS CITY, Mo., Central Supply Co.
KEWANEE, Ill., Mechanical Insulation Co., Inc.
LAKE CHARLES, La., Solar Supply Co.
LITTLE ROCK, Ark., Gunn Distributing Co.
LOS ANGELES, Calif., Western Fibrous Glass Prod. Co.
LOUISVILLE, Ky., General Insulation & Roofing Co.
MACON, Ga., Industry Insulation Co.
MARIETTA, Ohio, Asbestos & Insulating Co.
MEMPHIS, Tenn., John A. Denie's Sons, Co.
Gibbons Supply Co.
MIAMI, Fla., Reynolds Aluminum Supply Co.
Southern Metal Products Co.
MILWAUKEE, Wisc., F. R. Dengel Co.
MINNEAPOLIS, Minn., Asbestos Products, Inc.
MOBILE, Ala., Shook & Fletcher Insulation
MONTGOMERY, Ala., Shook & Fletcher Supply
MOORHEAD, Minn., Fargo-Moorhead Insulation Co.
NASHVILLE, Tenn., Reynolds Aluminum Supply Co.
NEWARK, N. J., Eastern Steam Specialty Co.
NEW ORLEANS, La., Eagle Asbestos & Packing Co.
NEW YORK, N. Y., Eastern Steam Specialty Co.
ODESSA, Tex., Western Chem. & Supply
OKLAHOMA CITY, Okla., Ball Distributing & Engr. Co.
OMAHA, Nebr., Cardinal Supply & Mfg. Co.
ORANGE, Conn., Insulation Supply Co.
PADUCAH, Ky., Triangle Insulation Co.
PHILADELPHIA, Pa., John F. Scanlan, Inc.
PHOENIX, Ariz., Kircher Asbestos & Rubber Co.
PITTSBURGH, Pa., Keystone Div. of Dravo Corp.
PORTLAND, Me., Eastern Glass Co.
PORTLAND, Ore., Western Fibrous Glass
RALEIGH, N. C., Reynolds Aluminum Supply Co.
RAPID CITY, S. D., Robbins & Stearns Wholesale
RICHMOND, Va., Reynolds Aluminum Supply Co.
ROANOKE, Va., C. E. Thurston Co.
ROCKFORD, Ill., Mott Brothers Co.
SALT LAKE CITY, Utah, Bullough Asbestos Sup. Co.
SAN ANTONIO, Tex., San Antonio Machine & Supply Co.
SAN DIEGO, Calif., Western Fibrous Glass Prod. Co.
SAN FRANCISCO, Calif., Western Fibrous Glass Prod. Co.
SAVANNAH, Ga., Reynolds Aluminum Supply Co.
SEATTLE, Wash., Western Fibrous Glass Products Co.
SHREVEPORT, La., Frith Sales Co.
SOMERVILLE, Mass., Insulation Products, Inc.
ST. LOUIS, Mo., The Stovey Company, Inc.
ST. PAUL, Minn., Asbestos Products, Inc.
SULLIVAN, Ill., Lewie David, Inc.
SYRACUSE, N. Y., Burnett Process, Inc.
TAMPA, Fla., Eagle Roofing & Art Metal Works, Inc.
TULSA, Okla., Ball Distributing & Engr. Co.
TUPELO, Miss., Paine Supply Co.
WASHINGTON, D. C., Walter E. Campbell Co., Inc.
WEST PALM BEACH, Fla., Southern Metal Prod.
WICHITA, Kans., General Metals, Inc.

SO 1-25-60

circle 278 on Reader Service card, p 103

Equipment news

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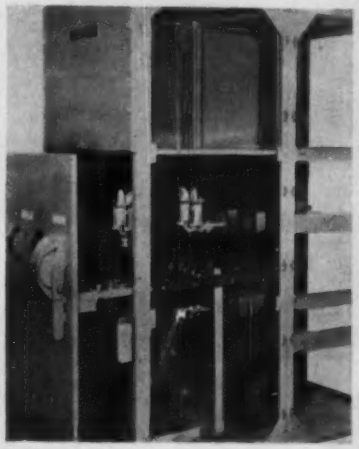


Air-interrupter switch

25 • Removable switch and fuse element are designed for service up to 14,400 v. When switch needs refusing, entire element is removed from its cubicle. Fuse is replaced without risk of contacting live parts. Fuse testing is safer, too, says maker. For system servicing, maintenance man rolls truck-mounted assembly out of cubicle onto floor, works in safety and comfort.

Toggle action is said to increase fault-current capacity. Currents up to 10,000 amp won't damage or weld the interrupter. — Continental Electric Equipment Co

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Centrifugal pump

47 • Seal-less centrifugal pump for leakproof handling of volatile, toxic, inflammable or other hazardous liquids has no mechanical seal, stuffing box or gland. Motor and pump are combined in integral unit. Pump capacity ranges up to 110 gal per min, heads up to 100 ft. Built-in thermal cut-out device protects motor if winding temperature exceeds maximum safe limit. Pump has two sizes with 1- and 1¼-in. discharge.— Gould Pumps, Inc

continued

PRESSURE REDUCING VALVE FOR GAS, OIL, WATER PRESSURES TO 300 psi

This cast iron valve with bronze trim is of single diaphragm, single composition seat construction and fills the broadest need for a tight closing valve in gas, oil, water service to 300 psi initial pressures.

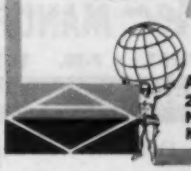
Outlet or regulated pressure spring ranges are 5-35, 20-60, 40-90.

This valve also is made with reverse seating arrangement to operate as a relief valve.

CHECK THESE FEATURES FOR YOURSELF

- ☐ Simple to service
- ☐ Balanced by piston for accurate regulation
- ☐ Silent operation. No hammer or chatter
- ☐ Wide adjustable reduced pressure range
- ☐ Single composition seat for dead end service
- ☐ Screwed ends
- ☐ Available in six sizes from ½" to 4"

SEND FOR BULLETIN 958



ATLAS VALVE CO.
280 South Street
Newark 5, N. J.
Mitchell 2-2464

circle 279 on Reader Service card, p 103

For MOST ECONOMICAL Cost-Per-Ton SERVICE

Use *Webster* Series 32 IDLERS

Quality-designed and quality-controlled for perfect and permanent roll alignment, economical operation, and minimum maintenance. Your coal-handling system can be improved with these WEBSTER features:

- **Heavy malleable iron roll ends provide rigid, perfectly aligned seats for the bearings.**
- **Strong inner steel tube connects the roll ends and provides grease reservoir for bearings.**
- **Rounded edges of the balanced steel rolls lock in the cast ends and protect the belt.**
- **Timken tapered roller bearings are oversize to meet overloading and constant operation.**
- **Labyrinth seals of metal and felt keep grease in and dirt out.**
- **Rolls easily removed. All parts interchangeable.**
- **Rigid malleable iron supporting brackets.**

You will be pleased with WEBSTER engineering and product service. Let us know your requirements.

***Webster* MANUFACTURING, INC.**

DEPT. P-50, TIFFIN, OHIO

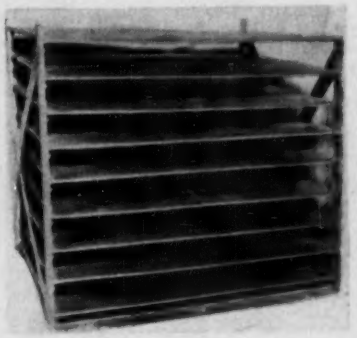
BULK MATERIALS HANDLING EQUIPMENT

SINCE 1878

Offices in All Principal Cities

Equipment news

Begins on page 122

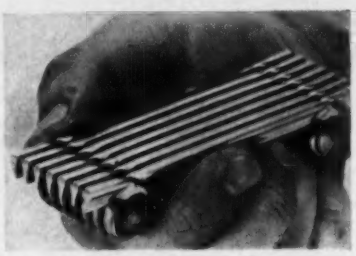


Heater-bank assembly

38 • Oven type plate heater-bank assembly handles air-conditioning-duct work. According to manufacturer, assembly provides high-capacity low-watt-density heat exchange, with fast heatup, minimum air-flow restriction.

Flat-plate heaters are mounted in tandem. All heater surfaces are electrically insulated, plated sheet steel. Banks connect for single- or 3-phase, 208-, 220- or 440-v service.—Electric Heater Specialty Co

Just circle key numbers on the Reader Service Card, page 103, to get complete product story



Self-cleaning screen

27 • Wedge wire making up this new screen features thinner profiles. High, narrow profiles permit more wires per area of working screen surface, increasing percentage of open area, screening and dewatering capacity.

Wedge-shaped profile cuts blinding and clogging—particle that passes top easily clears entire opening. Slit widths run down to 0.002

Another addition to the Vogt line of TOP QUALITY valves . . .

Forged Steel
WELDED BONNET

GENERAL GP PURPOSE

Gate and Globe
VALVES

150-800 Pounds Service

To eliminate forever potential body-bonnet leaks, Vogt engineers have developed these new General Purpose valves with seal welded bonnet joints.

This new addition to the world's most complete line of forged steel valves incorporates all the features of other Vogt GP valves—hard faced seats, hardened stainless steel wedges, drop forged pressure parts, and the numerous other advantages of Vogt's valve line.

The desirable safety feature of a back seat on the stem is retained while still offering the elimination of a possible body-bonnet leak.

Available NOW in both gate and globe types, ¼" thru 2", and in both socket weld and screw ends. These are priced identical to the bolted bonnet GP valves; gate valves the same as Series 12111 and globe valves the same as Series 12141.

Address Dept. 24A-FP for literature

Series 2801 Gate Valve
Illustrated

Series 2821 Globe Valve
Also Available

Both series identical in dimensions and have 13% chrome stainless steel trim.

Vogt GENERAL GP PURPOSE — Vogt FOR BETTER VALVES

HENRY VOGT MACHINE COMPANY, Louisville, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati.

FORGED STEEL VALVES

For more facts circle 281 on Reader Service card, p 103

This maintenance engineer is

Seveneering" with R/M

to overcome high breakaway friction

At the suggestion of his local R/M packing distributor, he is installing R/M Big 7 Packing Type #4 (oil-resistant packing R/M No. 376) because it is engineered to resist the destructive action of the high breakaway friction met in handling tar, asphalt and other viscous materials. Particularly adapted to refinery and pipeline equipment, such as reciprocating pumps, valve stems, and fluid end rods, it is made of exceptionally high-grade asbestos yarns with braid-over-braid construction. And each braided jacket is sealed with an oil-resistant compound that is unaffected by the action of petroleum derivatives.

When packing general acid processing equipment, he will use R/M No. 380—another Type 4 packing—made of crocidolite (blue asbestos) fiber impregnated with an acid-resistant lubricant.

Whatever your packing requirement, join the thousands of maintenance men "Seveneering" with R/M to reduce inventory and eliminate selection error. They know R/M's Big 7 Packings are engineered to do the job without compromise.

R/M Big 7 Packing Types are stocked by your authorized R/M distributor. Call him today. He will help solve your packing problems and supply your needs immediately from his stock, supplemented by R/M's strategically located warehouses.

R/M's Big 7 packing types meet 95% of all packing needs, are sold exclusively through authorized R/M distributors

This new R/M Big 7 Chart is a mighty handy reference. Send for your copy now.

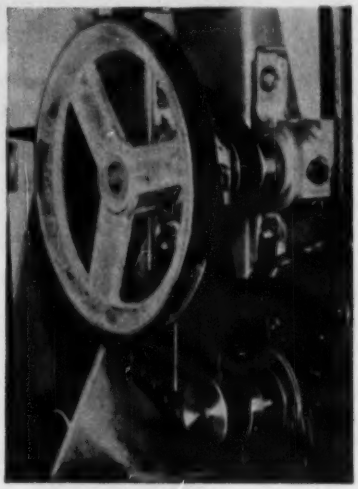
RM **BIG 7 PACKINGS**

RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Equipment news

Begins on page 122

in. Developed in Germany, screen is sold in U.S. by—National-Standard Company, Cross Perforated Metals Plant



Notched V-belt

41 • Notched V-belt is said to have quiet, vibrationless running characteristics, ruggedness and flexibility. It runs smoothly over small pulleys. Fully molded and jacketed construction eliminates flex cracking and increases fatigue resistance. Design feature is micro-positioned cord, formed into an arch through molding process. According to maker, design results in increased sidewall pressure providing more grip, little or no slippage and more-uniform pitch.—Raybestos-Manhattan, Inc, Manhattan Rubber Div

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Expanded-scale voltmeters

11 • Units are said to offer increased readability and precise indication of true rms values. They will give readings of alternating voltages even when their frequencies vary or when they are distorted. Voltmeters provide an accuracy of ± 0.5% of center-scale value at 60 cycles, are temperature compensated from −55 to

For more facts circle 282 on Reader Service card, p 103

circle 283 on Reader Service card, p 103 ▶

NEW FROM AMERICAN-STANDARD INDUSTRIAL DIVISION

Power-Lift† for power plants

through better design in surface condensers

Power-Lift is a timely new concept of coordinated products and services from American-Standard Industrial Division. Its purpose is to help you raise overall efficiency by offering products that are proved in the field—and designed, engineered, and manufactured to a uniform standard of quality and performance. American-Standard surface condensers, for example, have been continuously improved by development, research, and field experience over more than four decades. To see how their design improvements can benefit your plant operations . . .

†Service-mark of American Radiator & Standard Sanitary Corporation

lift the flap

American-Standard Industrial Division POWER-LIFT IN ACTION

surface cor

WITH TOMORROW'S DESIGN IMPROVEMENTS TODAY

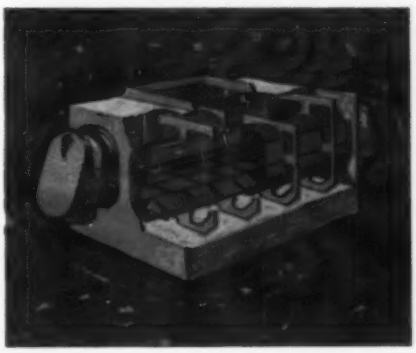
For the plant in your future you can plan with confidence using American-Standard surface condensers of today. They've made remarkable records of long, trouble-free life in producing design vacuum, zero degree depression hotwell temperature, and complete deaeration over a range of operating conditions—a result of many design improvements

Copyright 1960, American Radiator & Standard Sanitary Corporation

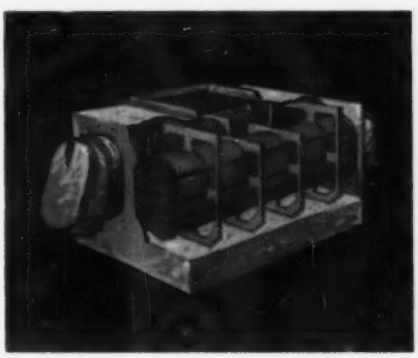
ndensers

and engineering features: Short steam path through tube bundle and improved steam distribution reduce pressure drop and assure top condensing efficiency of all tube surface. Pressurizing steam scoop traps inlet steam for deaerating hotwell. Hotwell deaerating trays further scrub condensate, completing deaeration and producing hotter feedwater. And new advance-design features reduce erection cost up to 65% over conventional methods.

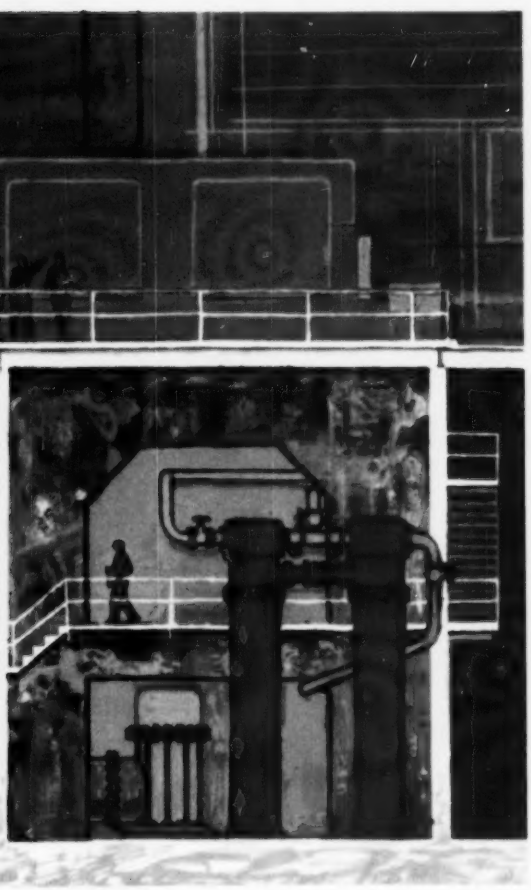
Moisture impingement grids extend tube life, and assure even distribution of steam.

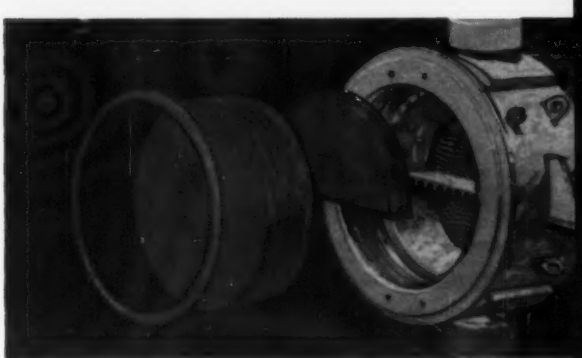


Condensate removal trays' unique location gives effective deaeration, higher vacuum.



Extremely low bundle entrance velocity, exceptionally large steam transportation lanes.





American-Standard feedwater heater has a closure designed for ease of assembly and disassembly—which won't leak, even against highest operating pressures. It's simple, with only four major parts: pass partition plate, closure, seal, weld or compression ring. Rugged...design stresses are much lower than required by ASME Code. Compact, with a diameter smaller than similar units.

As near as your phone . . . American-Standard Industrial Division Power-Lift Products and Services. Talk over your requirements with an American-Standard* Industrial Division product specialist. You'll find him well prepared and experienced—frequently able to base equipment recommendations upon precedents of proved success. And, in many instances, our comprehensive standardization paves the way to savings in time and cost. Offices in all principal cities. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario. Export Division, American-Standard, New York City.

AMERICAN-Standard
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

Surface condensers — Designed to service the largest of today's and tomorrow's steam turbines. Low bundle entrance velocity; liberal steam transportation lanes; moisture impingement grids to extend tube life; expansion diaphragms; effective deaeration and many other features created during 40 years of surface condenser development and research.

Mechanical draft fans — Complete range of sizes and types for forced draft, induced draft, gas recirculating, and primary air fan applications. Designed to meet rigid requirements of modern power plants where maximum pounds of steam are produced daily at peak efficiency. Airfoil, forward curved, backwardly inclined, radial, radial tip blades.

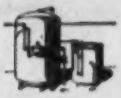
Feedwater heaters — Design incorporates unique new High Pressure Closure. Maintenance is simplified with only four major parts. Exceptionally high safety factor built into all units—more than double ASME Code requirements. Temperature stresses from start-ups or load changes virtually non-existent.

Heat exchangers — Designed and built with thoroughness and precision. Standard or specially engineered units for virtually all conditions and applications, including high pressure-high temperature exchangers, compressor inter- and after-coolers, fuel oil heaters, blow-down exchangers, and many others.

Gyrol® fluid drive — Provides stepless adjustable speed control for fans and boiler feed pumps. Performance, power savings, and reliability proved in the field. Units for motor driven boiler feed pumps or for "on-the-shaft" duty on main turbine generator. Drives are available for fan and pump duties for all boiler sizes.

Fly ash and dust collectors — Type "D" Dust Collector: mechanical "cyclone-type" collector. Series 342 Dust Collector: uses "cyclone" principle, with individual tubes which permit flexibility in design to fit plant layout. Series 361 Dust Collector: combines primary and secondary systems for high efficiency fly ash recovery.

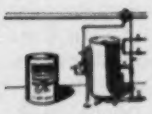
*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation



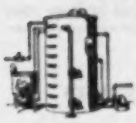
ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.

ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.

DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.

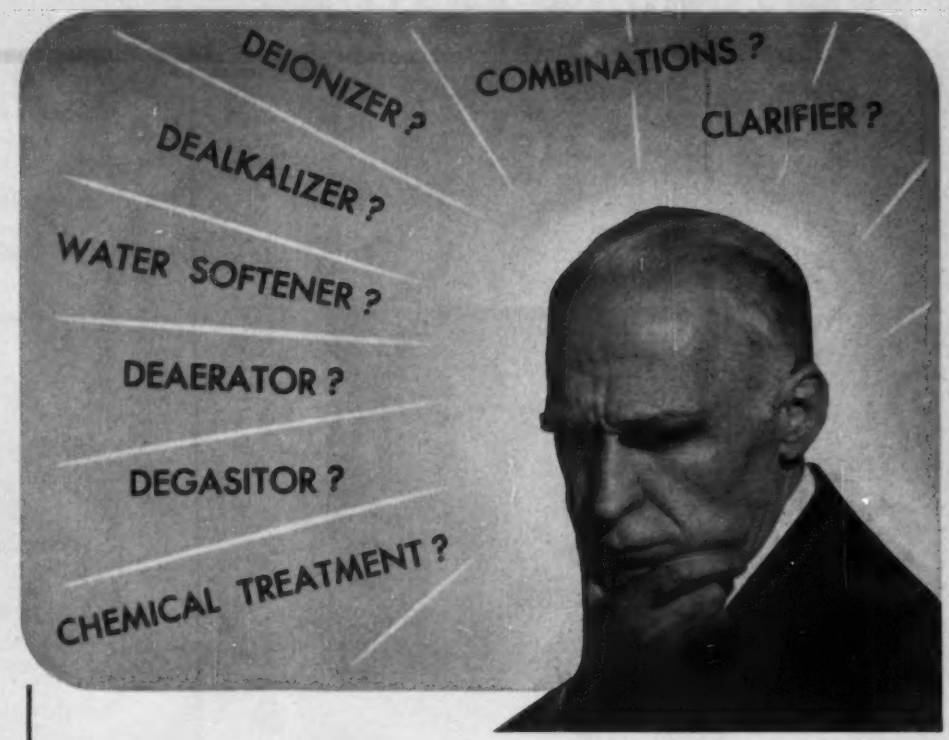


CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.



Confused about your water problem?

It isn't surprising that you should be confused about your water conditioning problem when you think about the almost endless ways of solving it that are being thrown at you from all directions in these fast moving times.

But instead of being confused, you should be happy that there *are* so many new roads open! Actually the confusion arises from the many new developments in water conditioning that have been crowded into recent years. And this is all to the good . . . for it means that today you can find a far, far better answer to your water problem.

Yes, your only basic problem is to sort out the one best way of meeting your particular needs from all the ways and means available today. This is the all important problem, but we have the answer to that one too: Simply take your set of conditions to a firm like Elgin—an organization that for more than fifty years has travelled all the roads of water conditioning—opened many of them. Out of Elgin experience will come the best, the most economical solution to your problem.

NEW 24 PAGE BULLETIN

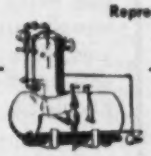
All the up-to-the-minute facts about Elgin equipment and service (briefly highlighted here) are covered by a new Bulletin 615 just off the press. It shows how Elgin experience — made available through your Elgin representative — can give you the one best answer to your problem.

Write for your copy!

ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities — ***In Canada: G. F. Sterne & Sons Ltd., Brantford***

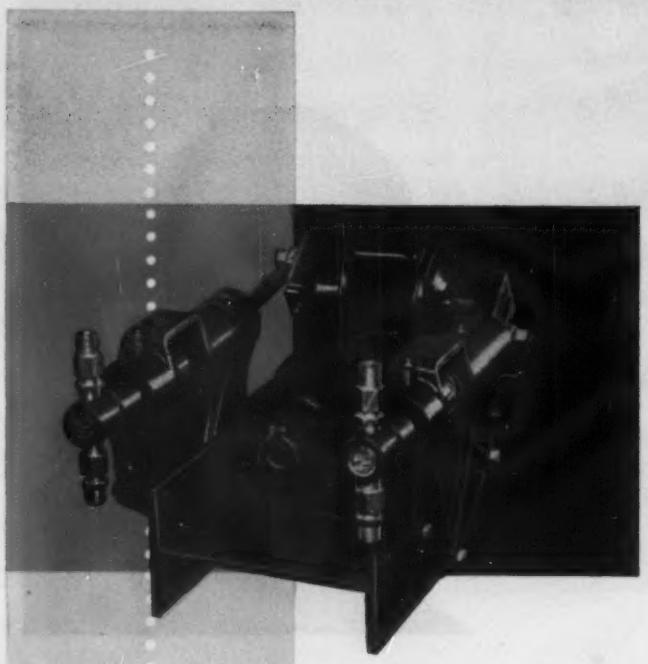


DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

For more facts circle 284 on Reader Service card, p 103

POSITIVE CONTROL OF MATERIALS IN MOTION B-I-F METERS FEEDERS CONTROLS



ONE PUMP PROPORTIONS ALKALINE, NEUTRAL OR ACID CHEMICALS

Proportioneers Adjust-O-Feeder

Gives Application Versatility At Low Initial Cost

Meet changing requirements without changing your entire pump! Low cost changeover, with plug-in reagent ends, makes Model 1140 Proportioneer® extremely versatile in the capacities and types of chemicals it can handle. Compare these performance characteristics with competitively priced pumps:

Accuracy within ±1% of set rate.
Adjustment range of 15:1 (not 10:1 as most).
Capacity from 0.8 gph to 850 gph.
Discharge pressures up to 1340 psig.

You'll find opportunities for cutting costs and improving efficiency in process feeding when you consult B-I-F — manufacturer of the most complete line of solid and liquid feeders.

B-I-F Industries

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA
METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

For complete details on Model 1140 request Bulletin 1140.20-1. Write **B-I-F Industries, Inc., 354 Harris Ave., Providence 1, R. I.**

Equipment news

Begins on page 122

70 C. Meters will indicate rms value even at triangular wave input.—Daystrom, Inc, Weston Instruments Div

Sanitary-tube welder

36 • Mark II welder is portable, rolls through any opening 28-in. wide. Hook it up with a 220-v 60-c 3-phase power connection to control box. Welds are said to be absolutely sanitary inside—no craters or pits. Tube and fittings from 1½ to 4 in. can be welded automatically—chart shows what control setting to use. Just clamp fixture to tubing, push start button, wait for machine to finish its job and shut itself off.—Cycl-O-Magic Inc

Just circle key numbers on the Reader Service card, page 103, to get complete product story

Finned-tank heaters

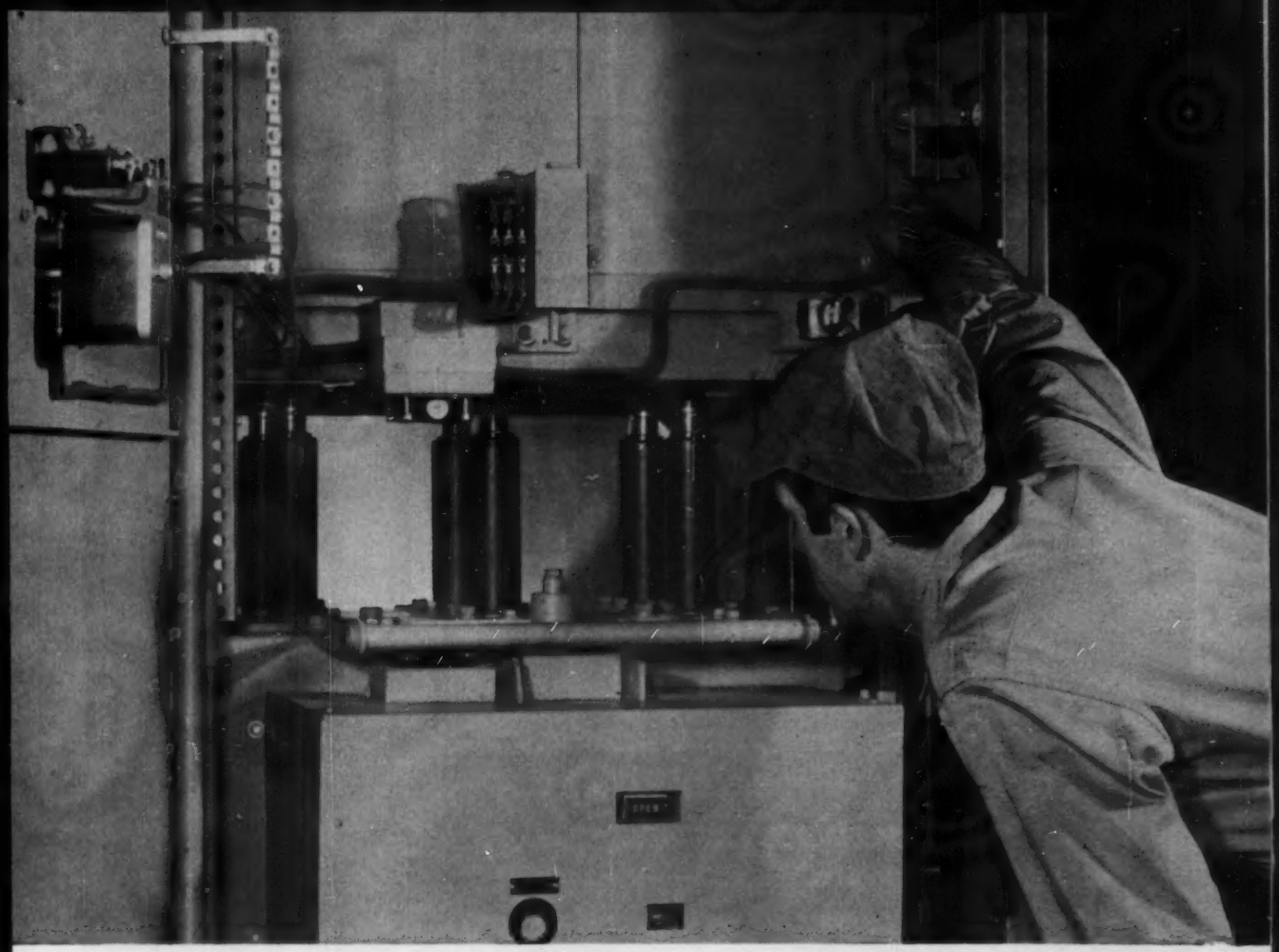
22 • Heavy-duty finned-tank heater was designed especially for corrosion problems in plants that must use poor-quality steam. Unit has pressure rating of 600 psi at 650 F, is manufactured of carbon steel or various alloys. It is available with vertical or off-the-floor design.—Brown Fintube Co

Portable air sampler

19 • Portable battery-operated air sampler frees user from power lines and line cord. Air pump, batteries,

Change hats with your maintenance man; he will demonstrate . . .

SAFETY YOU CAN SEE



Only General Electric *Vertical Lift* Metal-clad Switchgear lets you see when it's disconnected

When your maintenance man operates General Electric Vertical Lift Metal-clad switchgear he can *see* when the primary disconnects are parted. He knows the breaker is safely open—a really important safety factor when he's working with thousands of volts of electricity.

General Electric Vertical Lift is the only switchgear design which gives you this safety bonus. Allowing your operator to visually check also reduces the possibility of outages which damage equipment and halt production.

Safety you can see is another reason why General Electric manufactures Vertical Lift design Metal-clad switchgear.

Contact your General Electric switchgear representative for more information, or write for Metal-clad bulletin, GEA-5664, to Section 511-37, General Electric Company, Schenectady 5, New York.

VERTICAL LIFT'S 3 STEPS TO SWITCHGEAR SUPERIORITY:

STEP 1: (Illustrated) Disconnect breakers automatically—only Vertical Lift design permits operator to actually see when disconnects are parted.

STEP 2: Remove breaker, slide out box barrier—Vertical Lift design allows operator to inspect contacts without moving arc chutes.

STEP 3: Remove protective cover—only Vertical Lift Metal-clad has the breaker operating mechanism up front for easy access.

Progress Is Our Most Important Product

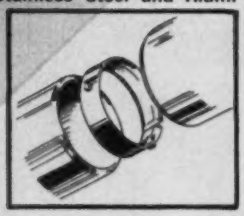
GENERAL ELECTRIC

For more facts circle 286 on Reader Service card, p 103

ROBVON BACKING RINGS

FAST • PRECISE TOLERANCE FIT-UPS

Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB automatically sets root gap. ROBVON rings are beveled to assure non-restricted fluid flow. Available in Carbon Steel, Wrought Iron, Chrome Alloys, Stainless Steel and Aluminum.



TYPE "CCC"

ROBVON BACKING RING CO.

Reg. Pat. Nos. 2,764,426 & 2,366,579 675 Garden St., Elizabeth 2, N. J., PH: EL 2-9613

For more facts circle 287 on Reader Service card, p 103

HIGH PSI – HIGH TEMP. NO PROBLEM... with these Butterfly Valves!

★ Inlet pressures up to 6000 psi
★ Pressure drops to 1200 psi
★ Temp. range −300°F to +2000°F
★ Sizes 1" to 108" in all ASA ratings
★ Closing speeds fast as 1/3 second
★ Equal percentage flow characteristics for accurate flow control

FISHER-CONTINENTAL

Heavy Pattern

BUTTERFLY VALVES

WRITE FOR BULLETIN NO. 76

FISHER GOVERNOR COMPANY

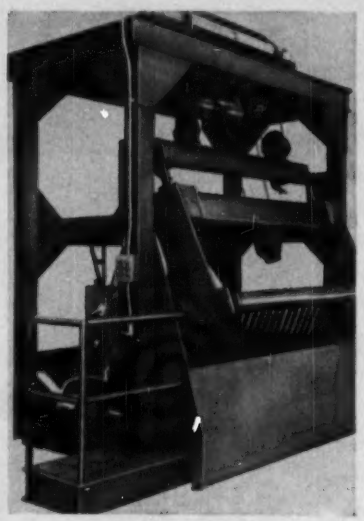
Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

Direct Inquiries to: CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Penna.

Equipment news

Begins on page 122

flowmeter, filter holder and battery charger are all contained in a durable shoulder bag. The complete unit weighs 14 lb. Battery sampler simplifies taking dust samples from tall stacks—flick a switch and sampler operates.—Gelman Instrument Co



Self-dumping rake

30 • Log-grapple trash-rack rake descends with teeth retracted. There's enough space between rack bars and basket teeth to clear accumulated trash. Going up, teeth engage rack bars, clean trash and dump it into a car. Available in 6- to 12-ft sizes, this rake frees water intakes of branches, boxes, tin cans.—Allis-Chalmers Manufacturing Company

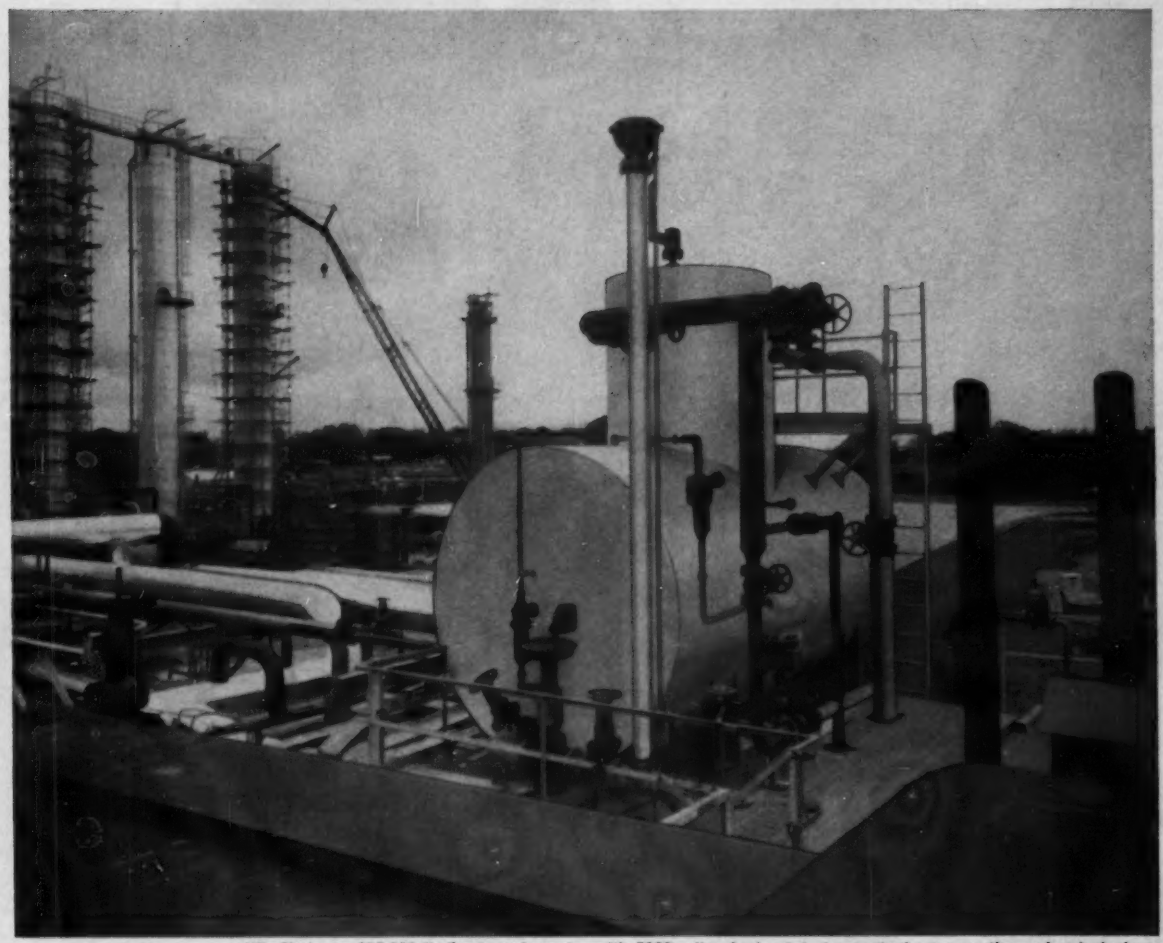
Just circle key numbers on the Reader Service card, page 103, to get complete product story

Simplified chlorinator

23 • Simplified stack-regulator design extends through entire chlorine-control section of Series-3400 chlorinators, improving accuracy, safety and flexibility, says maker. Basic model gives manual or automatic control over capacities from 0.1 to 2000 lb per day. Rigid single-unit glass-fiber cabinet protects against corrosion.—Fischer & Porter Co

ALLIS-CHALMERS

A-1233



Allis-Chalmers 215,000 lb./hr. tray deaerator with 7200-gallon horizontal storage tank at a southern chemical plant.

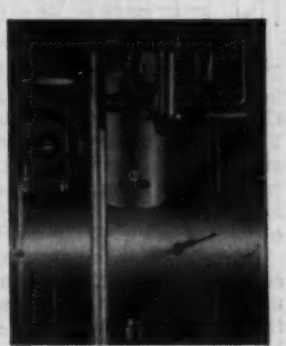
Corrosive gases removed

from boiler feedwater with Allis-Chalmers deaerators

Positive corrosive gas removal by Allis-Chalmers tray-type deaerators is proved by a pilot unit (below) equipped with a continuous oxygen analyzer and recorder. It utilizes unique counterflow design for thoroughly scrubbing dissolved gases from the water surface. Design produces maximum heating of water with minimum of steam loss in venting. Effective deaeration is guaranteed under all loads.

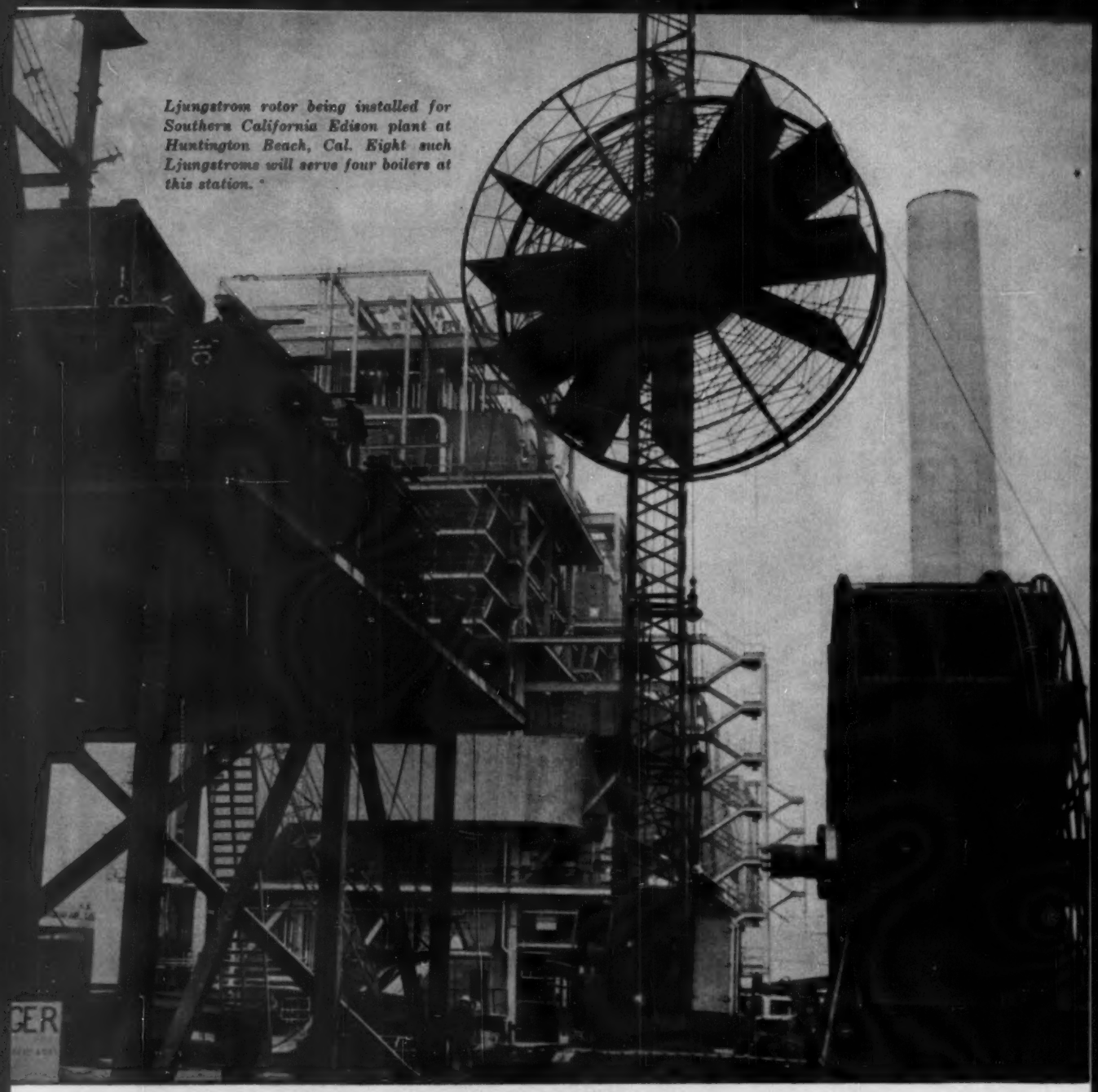
Ruggedly constructed, A-C deaerators employ 16-gauge 18-8 stainless steel on all equipment exposed to corrosive gases. No moving parts assures quiet operation, minimum maintenance. Inspection is easy through ample access doors and manholes. Service? Seventy-seven district offices throughout the nation. Your A-C water conditioning engineer can give you full deaerator details. **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin.

Pilot deaerator permits evaluation of tray designs.



"Standard" deaerators for small industrial power plants.

For more facts circle 289 on Reader Service card, p 103



Ljungstrom rotor being installed for Southern California Edison plant at Huntington Beach, Cal. Eight such Ljungstroms will serve four boilers at this station.

AIR PREHEATER SERVICE WILL STILL BE IN EFFECT ON THESE UNITS IN THE YEAR 2000

These new Ljungstrom® Air Preheaters, being installed at Southern California Edison's Huntington Beach Station, will be protected by an unusual service policy, one that guarantees regular inspection by Air Preheater engineers throughout the life of each unit.

There's no terminal date on this service — it's in effect as long as the units are in operation. In fact, Lifetime Air Preheater Service is still helping to keep the first Ljungstrom installation in the U.S. running perfectly, although it's been in operation almost 40 years.

Air Preheater provides first-rate *factory* service too, In one instance, in response to a last-minute decision to replace cold-end elements near the end of a scheduled shutdown, Air Preheater *fabricated and shipped* over 13,000 pounds of heating elements the day after the order was received.

Regular inspection and fast factory service are just two of the advantages Air Preheater offers its customers. Another is expert knowledge of boiler and preheater problems, gained through 35 years' experience. This combination—knowledge of customer problems and a *continuing* interest in them — probably explains why nine out of ten preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

For more facts circle 290 on Reader Service card, p 103

ALLIS-CHALMERS

One of the compact groups of A-C rubber-seated butterfly valves at the pumping station of a southwestern municipality.

The right valve "repeats itself"

66 Allis-Chalmers rubber-seated butterfly valves line up to prove it

Economical, dependable, easy to operate: Allis-Chalmers rubber-seated butterfly valves give you these and so many more advantages that it's easy to appreciate their universal popularity. Full body protection is provided by a rubber seat which extends through the valve body and over the flange faces. Angle seating protects the rubber seat and permits seating adjustment without costly disassembly.

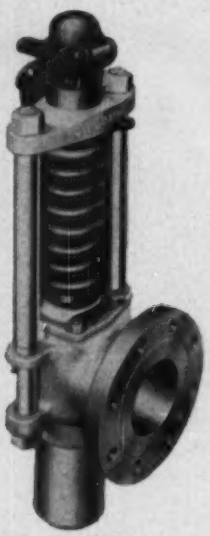
A-C manufactures a complete line of metal and rubber-seated butterfly valves in a wide range of types and sizes in order to provide the best valve for a given application. Compact design joins with light weight to bring other savings in both space and cost of construction.

• • •

For details on butterfly valves, cone valves and ball valves, contact your A-C representative or write **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1309

greater

CONSOLIDATED "MAXIFLOW" SAFETY VALVES set a new standard of capacity and tightness in high pressure steam service



Consolidated "Maxiflow" Safety Valve, Type 1700 Series. Sizes: 1½" through 6". Pressure to 3000 psi. Temperatures to 1120° F. for superheater and reheater service.

capacity

Consolidated "Maxiflow" Safety Valves have greater discharge capacity, seat tightness, and shorter blowdown essential to optimum service on today's high-pressure, high-temperature steam generating equipment.

The highest degree of valve tightness is achieved with the Thermodisc Seat, an exclusive Consolidated feature. This unique seating design permits rapid equalization of temperature differentials set up when a high pressure valve reseats after blowing. The Thermodisc minimizes thermal stresses which cause seat distortion. Result: permanent tightness that saves on steam and valve maintenance.

The Consolidated "Maxiflow" is designed to function with a minimum blowdown. Blowdown adjustment can be made with the valve under full pressure.

Bulletin 707B contains complete details about Consolidated "Maxiflow" Safety Valves. Write for a copy.

MANNING MAXWELL & MOORE INC. TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

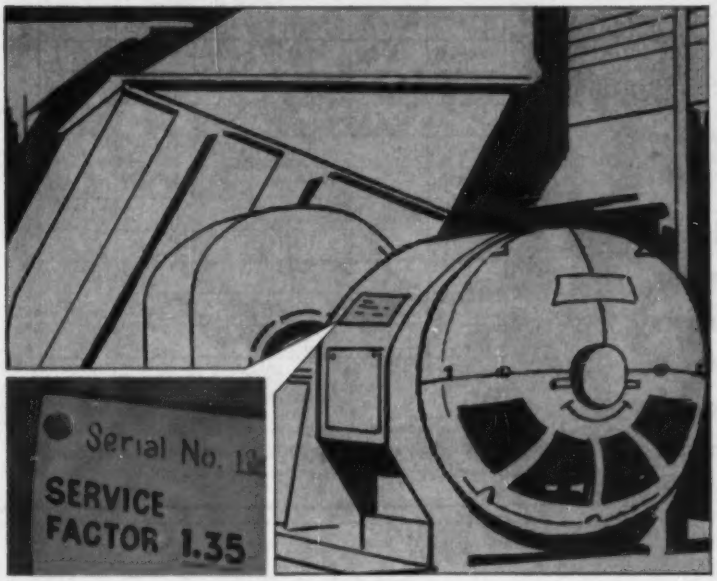
MANNING, MAXWELL & MOORE, INC.

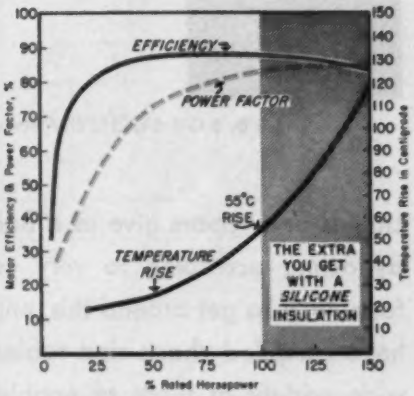
Valve Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 292 on Reader Service card, p 103

SILICONE NEWS from Dow Corning

Economy vs Reliability?





You Get Both When You Specify High Service Factor Motors for Auxiliary Drives

Motors built to entirely new design concepts are now available from leading manufacturers! They *look* like other motors. But they differ radically in performance . . . they'll carry overloads of fifteen to fifty percent *above* nameplate horsepower rating. They're insulated with Dow Corning Silicones for increased service factor!

THIS INCREASED SERVICE FACTOR:

1. ***Simplifies Motor Specifications.*** With increased service factor motors, you can match nameplate horsepower ratings to nominal loads . . . these motors are well-equipped to handle temporary, or even continuous overloads. Generally, there's no need to calculate maximum loads. All the safety factor that motors normally need . . . even for fan and pump loads . . . is already built-in!

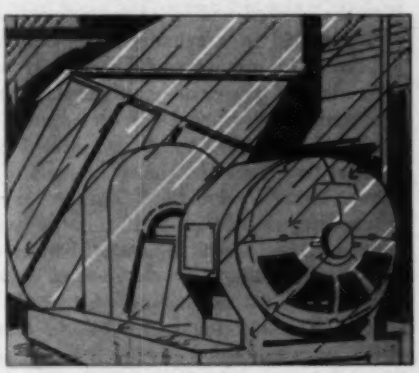
2. ***Reduces the Cost of Horsepower.*** With motors rated to average loads, the total installed horsepower is substantially less . . . and it costs less! If accepted application engineering practices are followed, additional savings result from lowered transformer and switchgear requirements . . . motor mounts and accessories cost less . . . and motors are easier to install.

3. ***Increases Reliability.*** In addition to increased service factor, thermally stable Dow Corning silicone insulation assures motor reliability in the high ambient areas near boilers, stacks, and high temperature processing equipment.

For more information on what silicone insulated service factor motors can mean to you, write Dept. 6905.

How do manufacturers build so much extra into a motor? By substituting an insulation system made from Dow Corning Silicones for the Class A insulation systems used in standard lines. Only the insulation is changed. Frame, electrical steel and copper remain the same. And there's one change on the nameplate—*service factor rating goes up!*

On a TEFC motor, for example, service factor goes up from 1.00 with Class A insulation materials to somewhere between 1.15 and 1.50 when silicones are used.



Simplify Enclosures. You can also save by specifying silicone-insulated motors for outdoor service. The reason: "Self-protecting" insulation systems made with Silastic®, the Dow Corning silicone rubber, require no premium priced enclosures. You can specify open frames. No need to protect the insulation against outdoor elements.

SPECIFY Dow Corning Silicones and SAVE!

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

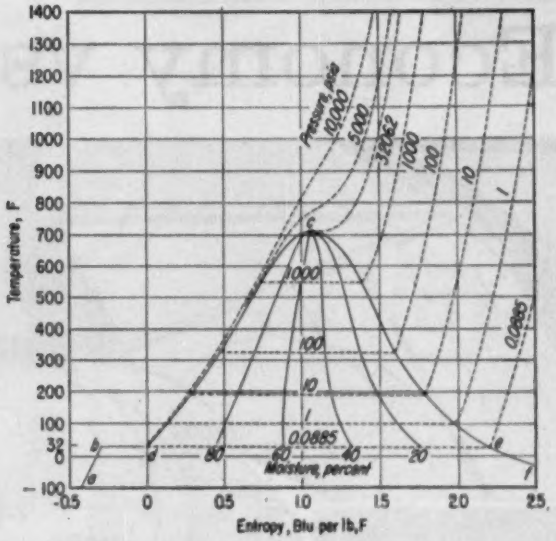
ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

For more facts circle 293 on Reader Service card, p 103

THERMO REFRESHER NO. 38

By B G A SKROTZKI, Associate Editor

Liquids and vapors give us a hard time by acting according to very complex formulas. To get around this, engineers have compiled charts and tables for a wide variety of fluids to enable quick solution of problems in thermodynamic processes and cycles



1 Temperature-entropy diagram for steam features symmetrical shape of saturated liquid and vapor lines meeting at point *c*

Vapor charts speed process calculations

Last month we studied the P-V graph for steam and tied it to the idea of adding or extracting heat from one lb of water held in a cylinder and piston under constant pressure. This graph is useful because areas on it bounded by reversible processes measure the mechanical work produced or absorbed by a cycle, see Part 7, POWER, April 1957, pp 96-99 and Part 8, May 1957, pp 106-109.

Heat transferred. The counterpart of the P-V graph for measuring work is the T-S graph for measuring heat produced or absorbed, Fig. 1. Here we have lines of constant pressure, a locus of saturated water *cd* and a locus for saturated steam *cef* and lines of constant moisture.

Let's trace the state changes for one lb of ice held in a cylinder and piston under 10-psia constant pressure. If the ice is subcooled at –100 F it will be at point *a* in Fig. 1. As we add heat to the ice its temperature and entropy both rise along line *ab* till it reaches 32 F.

Further heating then starts melting the ice along line *bd*. The temperature of both ice and water stays constant at 32 F, but entropy of the mixture of saturated ice and subcooled water rises. We looked at the molecular reasons last month. At point *d* all ice has melted to a subcooled water.

Line *bd* corresponds to the triple point on the P-T plot we studied last month. Along this line a mixture of saturated ice, saturated steam and saturated water can exist in one mixture.

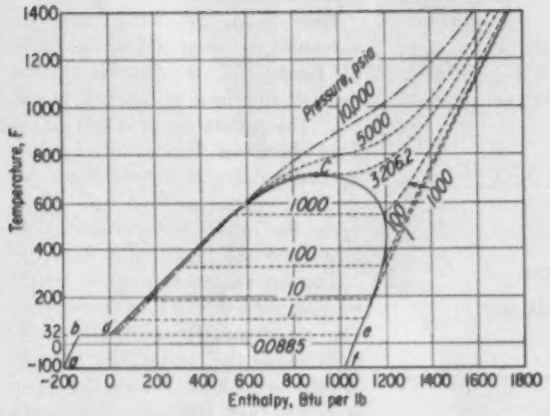
Now an important point: All enthalpies for the fluid water in all its states are reckoned from 32 F as a base. This makes both enthalpy and entropy *zero* at this temperature and corresponding saturation pressure. As a result enthalpy and entropy for ice are both negative values, being less than zero relatively.

Returning to our example, when we add heat to the subcooled water at 32 F and 10 psia both temperature and entropy rise along the saturated-water locus *dc* (this is not true at higher pressures; more about this later). When the temperature reaches 193.2 F the water is saturated and starts to vaporize; that is, it boils to form saturated steam at the same temperature.

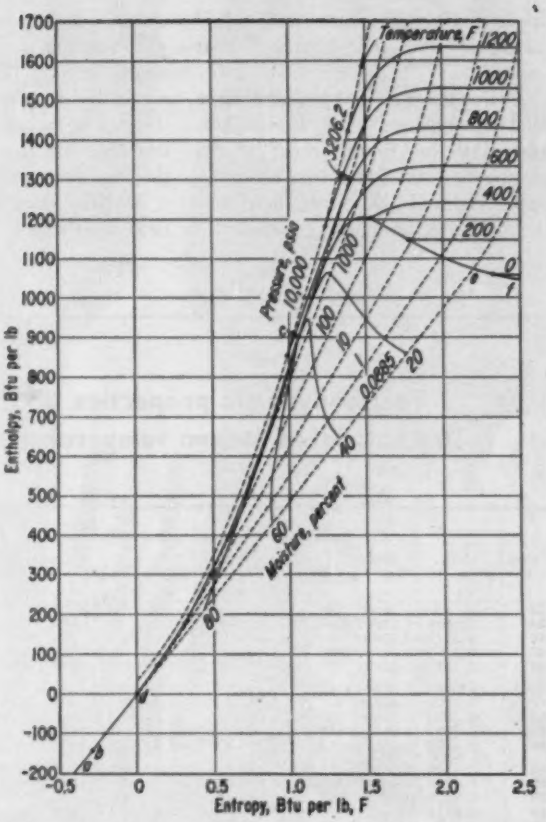
Boiling takes place while temperature of both saturated water and saturated steam stays constant, but entropy of the mixture rises. Moisture percentage of the saturated mixture decreases with rising entropy, being 100% at the saturated-liquid locus *dc* and 0% at the saturated-vapor locus *cef*. When heating has completely evaporated the water we have everything as saturated steam, and its state lies on the saturated-vapor locus.

Further heating of the 10-psia steam makes both its temperature and entropy rise as it becomes superheated steam. At the higher temperatures, superheated steam begins to act like a gas because of its large specific volume. Its behavior can be figured closely from the ideal-gas equation, $PV=RT$.

T-S graph areas. Remembering the properties of the T-S graph (Part 10, July 1957, pp 88-91), we see that total area under the line *bd* down to absolute zero temperature at –460 F measures the latent enthalpy of



2 Highly variable specific heats of water and steam and latent enthalpies make complicated relation of temperature, enthalpy



3 Mollier diagram gives relation of enthalpy and entropy for steam for constant pressures, constant temperatures, constant moisture and saturated water and saturated steam. Plotted to large scale, this diagram can be used instead of steam tables

fusion for ice melting to water; inversely it measures heat given up by water freezing to ice.

The total area, down to absolute zero, under the saturated-water locus from *d* to the pressure line for 10 psia measures the heat for warming the 10-psia water from 32 F to its saturation temperature at 193.2 F. Total area under the horizontal 10-psia pressure line in the saturation or wet region measures the latent enthalpy of vaporization at that pressure.

Total area under the 10-psia line in the superheat region measures heat needed to raise the steam to a given temperature from the saturation temperature.

Latent enthalpies. Most of the constant-pressure lines in Fig. 1 converge into the saturated-water locus as both entropy and temperature drop. At pressures above about 400 psia the lines tend to lie slightly to the left of the saturated-water line, as indicated by the 5000- and 10,000-psia lines which do not merge with the saturated-water locus line *c-d*.

For accurate calculations at higher pressures corrections should be made for this *compressed-liquid* state, another term for subcooled liquid. More about this later.

Shape of the wet region between the saturated-water and -steam lines shows that the latent enthalpy of steam is very large at low pressures. As pressure rises the latent enthalpy shrinks until at the critical point *c* it reduces to zero. As we learned last month, above the critical pressure there is no boiling action as we heat water to steam. Water gradually expands like a very dense gas, forming no bubbles, and we arbitrarily call the fluid *water* below the critical temperature of 705.4 F and *steam* above this temperature at pressures above the critical of 3206.2 psia. We now have plants working in this area.

At pressures below the triple point at 32 F and 0.0885 psia we have the latent enthalpy of sublimation where ice sublimes to steam, or inversely steam condenses to ice (usually as hoar frost). No intermediate liquid phase exists in this range of very low pressures (Part 37, April 1960, pp 172-174). Notice the large sudden increase in latent enthalpy in Fig. 1 below the triple point, line *bd* in the T-S graph.

We seldom, if ever, work in this region below 32 F when using thermodynamic power cycles. We're considering it just to complete the picture of physical behavior of matter over a wide range of states.

T-H graph, Fig. 2, reflects the complex variation in specific heats of water and steam. While the specific heats of actual gases also vary, Part 5, January 1957, pp 96-99, they are so gradual that a plot like Fig. 2 for gases would be a set of nearly straight lines sloping upward to the right.

Compared to Fig. 1, Fig. 2 looks like a warped T-S diagram. Here again we can identify the subcooled-ice locus *ab*, the melting locus *bd* (corresponding to the

triple point), the saturated-liquid locus *dc* and the saturated-vapor locus *cef*.

Again the constant-pressure lines tend to converge at the lower pressures into the liquid locus; at the superheated states they soar off to the upper right. In this area, note that the pressure lines are crowded together much more than on the T-S graph in Fig. 1. We seldom use this chart in practical thermodynamic work, but it gives us a good introduction to the range of enthalpy values that we must work with when dealing with steam and water.

Mollier diagram, Fig. 3, is the most-used chart in steam work—it plots steam and water enthalpy against entropy with curves for constant pressure, constant temperature, constant moisture, the saturated-liquid and the saturated-vapor locus.

Here again we can identify the subcooled-ice locus *ab*, the enthalpy of fusion *bd*, the saturated-liquid locus *dc* and the saturated-vapor locus *cef*. The critical point stands at *c*. This chart has great utility because we can quickly relate enthalpies for constant-entropy processes. Here again the lower pressure lines converge into the liquid-locus line.

The wet region appears as a very warped version of the T-S diagram. The superheat region in the upper right shows the temperature lines as being practically horizontal for pressures less than 100 psia. This shows that a simple $H = cT$ relation holds for the steam in the upper superheat region. In other words, steam acts very much like an ideal gas in this area.

Steam Tables. By drawing Mollier diagrams to very large scales we can read enthalpies to within 0.1 Btu per lb, but the chart is very large and somewhat awkward to handle. The *Steam Table* has been the standard way of finding the properties when calculating processes. There are three main tables: (1) saturation—temperature (2) saturation—pressure and (3) superheated vapor. In addition there are tables for (4) compressed liquid and (5) saturation—solid-vapor.

Saturation — temperature table is shown at left. This is only an abstract of the complete table covering six pages in *Thermodynamic Properties of Steam* by Keenan and Keyes, published by John Wiley and Sons. In this table all the properties of saturated steam and saturated water are listed against even values of temperature in degrees Fahrenheit, in the first column under symbol *t*.

Second column has the corresponding saturation pressure *p*. Columns 3, 4 and 5 have the specific volumes of water and steam and their difference. Columns 6, 7 and 8 have the enthalpies for water and steam and their difference; columns 9, 10 and 11 have the entropies for water and steam and their difference.

Next month we'll talk more about Steam Tables.

Thermodynamic properties of steam
Dry saturated steam: temperature table*

Temp, F t	Abs press., psi p	Specific volume: Sat. liquid v_f	Specific volume: Evap v_{fg}	Specific volume: Sat. vapor v_g	Enthalpy: Sat. liquid h_f	Enthalpy: Evap h_{fg}	Enthalpy: Sat. vapor h_g	Entropy: Sat. liquid s_f	Entropy: Evap s_{fg}	Entropy: Sat. vapor s_g	Temp, F t
32	0.08854	0.01602	3306	3306	0.00	1075.8	1075.8	0.0000	2.1877	2.1877	32
35	0.09995	0.01602	2947	2947	3.02	1074.1	1077.1	0.0061	2.1709	2.1770	35
40	0.12170	0.01602	2444	2444	8.05	1071.3	1079.3	0.0162	2.1435	2.1597	40
45	0.14752	0.01602	2036.4	2036.4	13.06	1068.4	1081.5	0.0262	2.1167	2.1429	45
50	0.17811	0.01603	1703.2	1703.2	18.07	1065.6	1083.7	0.0361	2.0903	2.1264	50
60	0.2563	0.01604	1206.6	1206.7	28.06	1059.9	1088.0	0.0555	2.0393	2.0948	60
70	0.3631	0.01606	867.8	867.9	38.04	1054.3	1092.3	0.0746	1.9902	2.0647	70
80	0.5069	0.01608	633.1	633.1	48.02	1048.6	1096.6	0.0932	1.9428	2.0360	80
90	0.6982	0.01610	468.0	468.0	57.99	1042.9	1100.9	0.1115	1.8972	2.0087	90
100	0.9492	0.01613	350.3	350.4	67.97	1037.2	1105.2	0.1295	1.8531	1.9826	100
110	1.2748	0.01617	265.3	265.4	77.94	1031.6	1109.5	0.1471	1.8106	1.9577	110
120	1.6924	0.01620	203.25	203.27	87.92	1025.8	1113.7	0.1645	1.7694	1.9339	120
130	2.2225	0.01625	157.32	157.34	97.90	1020.0	1117.9	0.1816	1.7296	1.9112	130
140	2.8886	0.01629	122.99	123.01	107.89	1014.1	1122.0	0.1984	1.6910	1.8894	140
150	3.718	0.01634	98.06	97.07	117.89	1008.2	1126.1	0.2149	1.6537	1.8685	150
160	4.741	0.01639	77.27	77.29	127.89	1002.3	1130.2	0.2311	1.6174	1.8485	160
170	5.992	0.01645	62.04	62.06	137.90	996.3	1134.2	0.2472	1.5822	1.8293	170
180	7.510	0.01651	50.21	50.23	147.92	990.2	1138.1	0.2630	1.5480	1.8109	180
190	9.339	0.01657	40.94	40.96	157.95	984.1	1142.0	0.2785	1.5147	1.7932	190
200	11.526	0.01663	33.62	33.64	167.99	977.9	1145.9	0.2938	1.4824	1.7762	200
210	14.123	0.01670	27.80	27.82	178.05	971.6	1149.7	0.3090	1.4508	1.7598	210
212	14.696	0.01672	26.78	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566	212
220	17.186	0.01677	23.13	23.15	188.13	965.2	1153.4	0.3239	1.4201	1.7440	220
230	20.780	0.01684	19.365	19.382	198.23	958.8	1157.0	0.3387	1.3901	1.7288	230
240	24.969	0.01692	16.306	16.323	208.34	952.2	1160.5	0.3531	1.3609	1.7140	240
250	29.825	0.01700	13.804	13.821	216.48	945.5	1164.0	0.3675	1.3323	1.6998	250
260	35.429	0.01709	11.746	11.763	228.64	938.7	1167.3	0.3817	1.3043	1.6860	260
270	41.858	0.01717	10.044	10.061	238.84	931.8	1170.6	0.3958	1.2769	1.6727	270
280	49.203	0.01726	8.628	8.645	249.06	924.7	1173.8	0.4096	1.2501	1.6597	280
290	57.556	0.01735	7.444	7.461	259.31	917.5	1176.8	0.4234	1.2238	1.6472	290
300	67.013	0.01745	6.449	6.466	269.59	910.1	1179.7	0.4369	1.1980	1.6350	300
310	77.68	0.01755	5.609	5.626	279.92	902.6	1182.5	0.4504	1.1727	1.6231	310
320	89.66	0.01765	4.896	4.914	290.28	894.9	1185.2	0.4637	1.1478	1.6115	320
330	103.06	0.01776	4.289	4.307	300.68	887.0	1187.7	0.4769	1.1233	1.6002	330
340	118.01	0.01787	3.770	3.788	311.13	879.0	1190.1	0.4900	1.0992	1.5891	340
350	134.63	0.01799	3.324	3.342	321.63	870.7	1192.3	0.5029	1.0754	1.5783	350
360	153.04	0.01811	2.939	2.957	332.18	862.2	1194.4	0.5158	1.0519	1.5677	360
370	173.37	0.01823	2.606	2.625	342.79	853.5	1196.3	0.5286	1.0287	1.5573	370
380	195.77	0.01836	2.317	2.335	353.45	844.6	1198.1	0.5413	1.0059	1.5471	380
390	220.37	0.01850	2.0651	2.0836	364.17	835.4	1199.6	0.5539	0.9832	1.5371	390
400	247.31	0.01864	1.8447	1.8633	374.97	826.0	1201.0	0.5664	0.9608	1.5272	400
410	276.75	0.01878	1.6512	1.6700	385.83	816.3	1202.1	0.5788	0.9386	1.5174	410
420	308.83	0.01894	1.4811	1.5000	396.77	806.3	1203.1	0.5912	0.9166	1.5078	420
430	343.72	0.01910	1.3308	1.3499	407.79	796.0	1203.8	0.6035	0.8947	1.4982	430
440	381.59	0.01926	1.1979	1.2171	418.90	785.4	1204.3	0.6158	0.8730	1.4887	440
450	422.6	0.0194	1.0799	1.0993	430.1	774.5	1204.6	0.6280	0.8513	1.4793	450
460	466.9	0.0196	0.9748	0.9944	441.4	763.2	1204.6	0.6402	0.8295	1.4700	460
470	514.7	0.0198	0.8811	0.9009	452.8	751.5	1204.3	0.6523	0.8083	1.4606	470
480	566.1	0.0200	0.7972	0.8172	464.4	739.4	1203.7	0.6645	0.7868	1.4513	480
490	621.4	0.0202	0.7221	0.7423	476.0	726.8	1202.8	0.6766	0.7653	1.4419	490
500	680.8	0.0204	0.6545	0.6749	487.8	713.9	1201.7	0.6887	0.7438	1.4325	500
520	812.4	0.0209	0.5385	0.5594	511.9	686.4	1198.2	0.7130	0.7006	1.4136	520
540	962.5	0.0215	0.4434	0.4649	536.6	656.6	1193.2	0.7374	0.6568	1.3942	540
560	1133.1	0.0221	0.3647	0.3868	562.2	624.2	1186.4	0.7621	0.6121	1.3742	560
580	1325.8	0.0228	0.2989	0.3217	588.9	588.4	1177.3	0.7872	0.5659	1.3532	580
600	1542.9	0.0236	0.2432	0.2668	617.0	548.5	1165.5	0.8131	0.5176	1.3307	600
620	1786.6	0.0247	0.1955	0.2201	646.7	503.6	1150.3	0.8398	0.4664	1.3062	620
640	2059.7	0.0260	0.1538	0.1798	678.6	452.0	1130.5	0.8679	0.4110	1.2789	640
660	2365.4	0.0278	0.1165	0.1442	714.2	390.2	1104.4	0.8987	0.3485	1.2472	660
680	2708.1	0.0305	0.0810	0.1115	757.3	309.9	1067.2	0.9351	0.2719	1.2071	680
700	3093.7	0.0369	0.0392	0.0761	823.3	172.1	995.4	0.9905	0.1484	1.1389	700
705.4	3206.2	0.0503	0	0.0503	902.7	0	902.7	1.0580	0	1.0580	705.4

* Abridged from *Thermodynamic Properties of Steam* by Joseph H Keenan and Frederick G Keyes, John Wiley & Sons, Inc, New York

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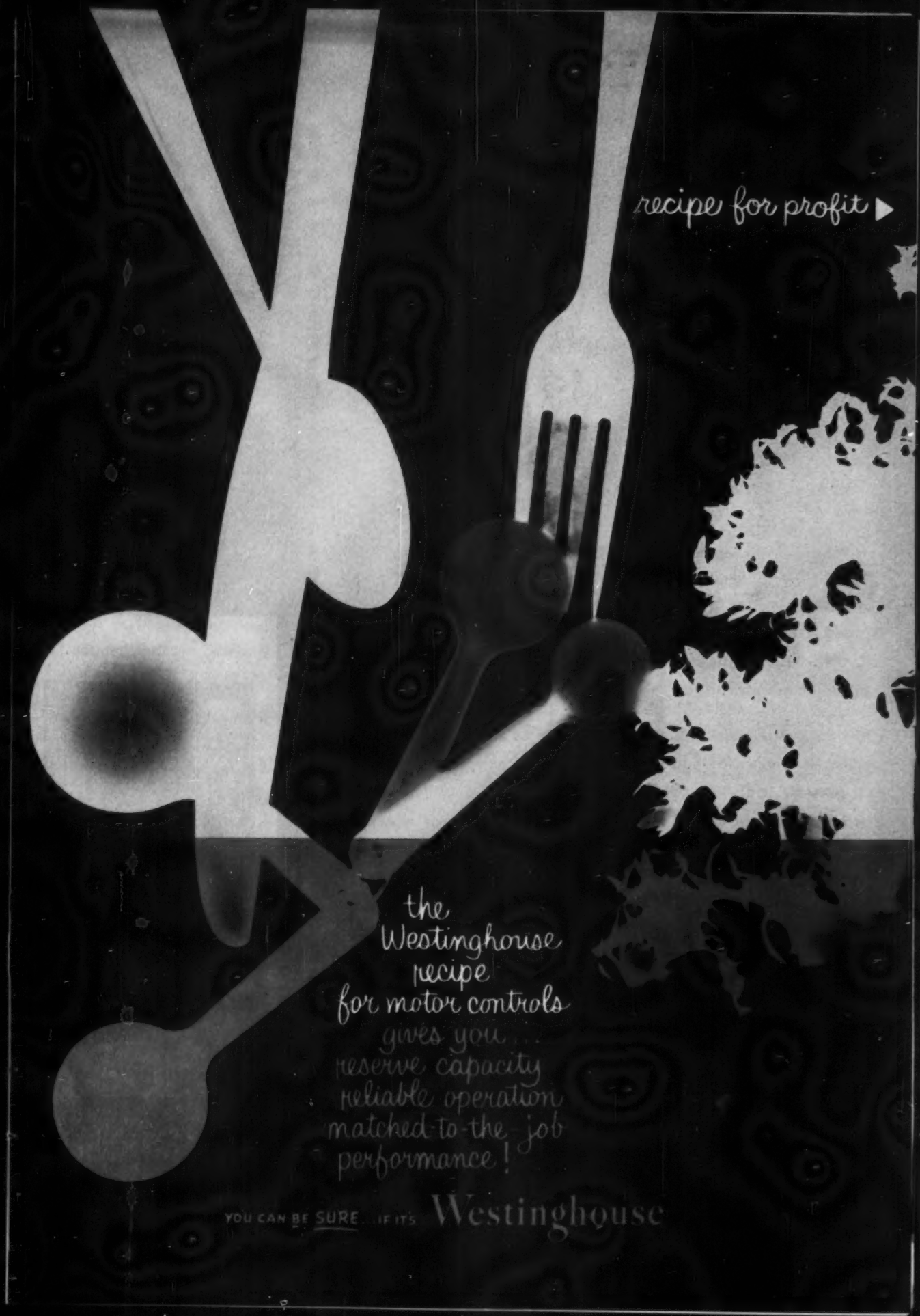
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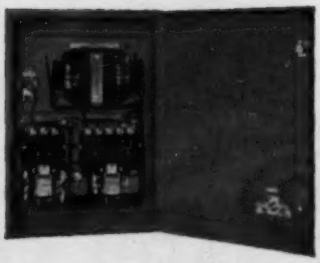

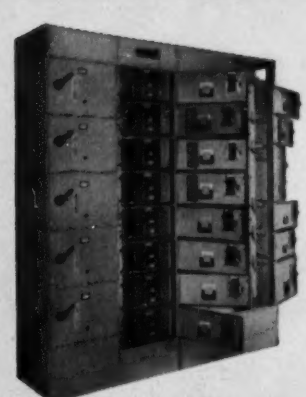

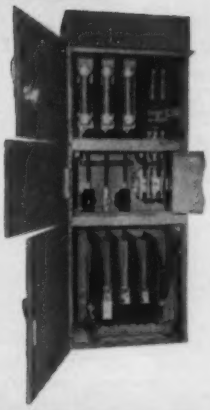

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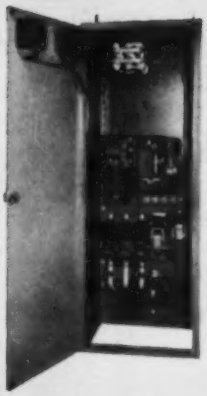

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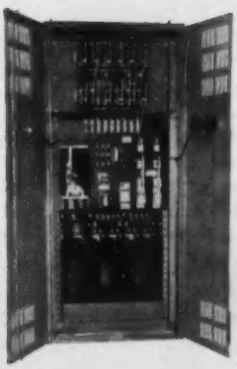
Interchangeable modular construction.



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Completely static units — essentially maintenance-free.

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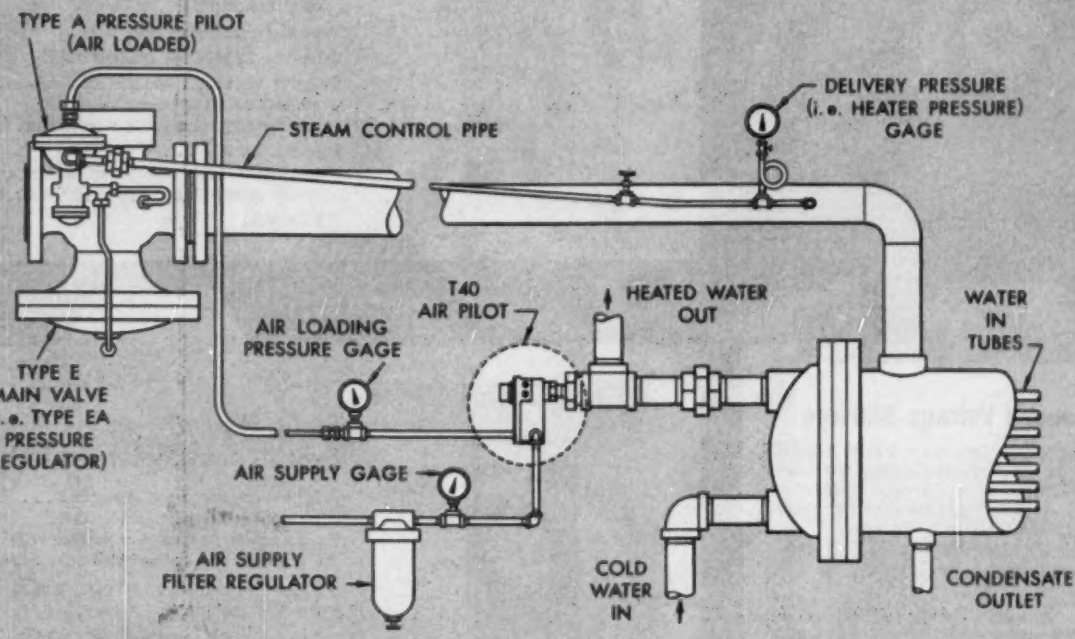
VALVE TIPS:

New Spence Temperature Control System Gives Unusual Control Accuracy


TYPE A PRESSURE PILOT (AIR LOADED)
STEAM CONTROL PIPE
DELIVERY PRESSURE (i. e. HEATER PRESSURE) GAGE
T40 AIR PILOT
HEATED WATER OUT
WATER IN TUBES
AIR LOADING PRESSURE GAGE
TYPE E MAIN VALVE (i. e. TYPE EA PRESSURE REGULATOR)
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TYPE EAT40 AIR-CONTROL TEMPERATURE REGULATOR (Patent Pending)

In a recent installation the new Spence air-control temperature regulating system provided:

- ±5°F control accuracy under wide and instantaneous load swings of 210 to 80 gallons per minute.
- Up to 50% reduction in cost as compared to instrument systems of similar accuracy.

This unique cascade-type control with throttling range adjustment independent of maximum heater pressure was developed to meet today's demand for greater control accuracy.

Additional features of the new Spence Temperature Control System include:

- 200°F wide adjustable temperature range
- Adjustable speed of steam pressure change
- Over and under temperature protection
- Pressure limit control
- Fast response
- Very low air consumption
- Field reversible for heating or cooling

The Spence Type EAT Air Control Temperature System, when properly installed, will tame wide ranging, fast changing loads of instantaneous heaters and modern heat exchangers. The cascade principle plus the use of an extremely fast responding bi-metal temperature sensing element reduce time lags and provide control stability.

Here's how the new Spence system operates:

Quick response is based on a bi-metal temperature sensing element. Temperature pilot continuously regulates a loading air pressure.

This loading signal, when applied to a pressure regulator to reflect heater temperatures, causes it to adjust the main valve as changes in load require.

Spence has also developed a new pressure control system based on this same cascade principle. This system has a control accuracy of ½ psi or better from positive pressures through the vacuum range to 30" Hg.

For complete information on these new air controlled temperature and pressure control systems, write for your copy of Bulletin 9.

SPENCE ENGINEERING COMPANY, INC.
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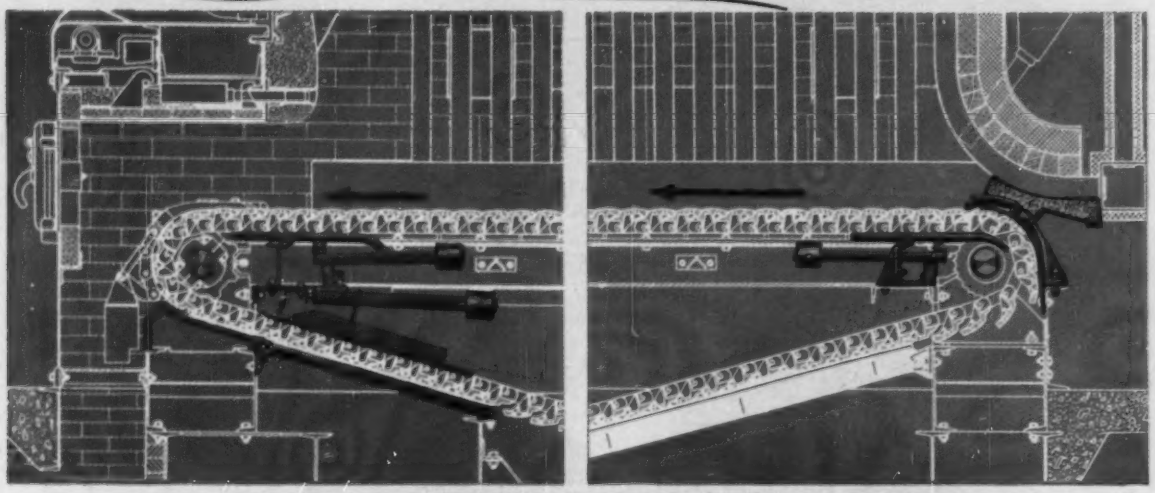
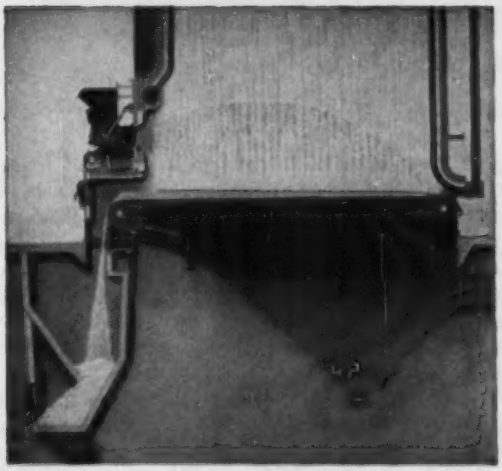
DOWN WITH EXCESS AIR!



Floating Front and Rear Grate Seals—A Detroit RotoGrate Exclusive. They decrease excess air.

Automatic Air Seals Exclusive With Detroit RotoGrate Stokers Reduce Excess Air to 22% and Lower



Detroit RotoGrate Stoker — an advanced design spreader stoker with forward moving grates, for medium and large boilers. Burns all ranks of bituminous coals and lignites without special preparation . . . also many waste or refuse fuels, either alone or in combination with coal. Efficiency is high — maintenance low.

Many users reduce excess air to 22% or under, due to these free floating automatic front and rear seals with adjustable counterweights. They really seal, and stay sealed even after years of service. Air is directed to the active combustion zone. The result is increased combustion efficiency and economy.

The rear under-grate seal plate provides a quiet coking section which extends across the furnace . . . expedites the ignition of green fuel.

These and many other exclusive features of advanced design make Detroit Stokers your best buy. There is a type and size Detroit Stoker for any boiler capacity from 3,000 to 400,000 pounds steam per hour.

DETROIT STOKERS COST LESS: COST = INITIAL INVESTMENT + UPKEEP + PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

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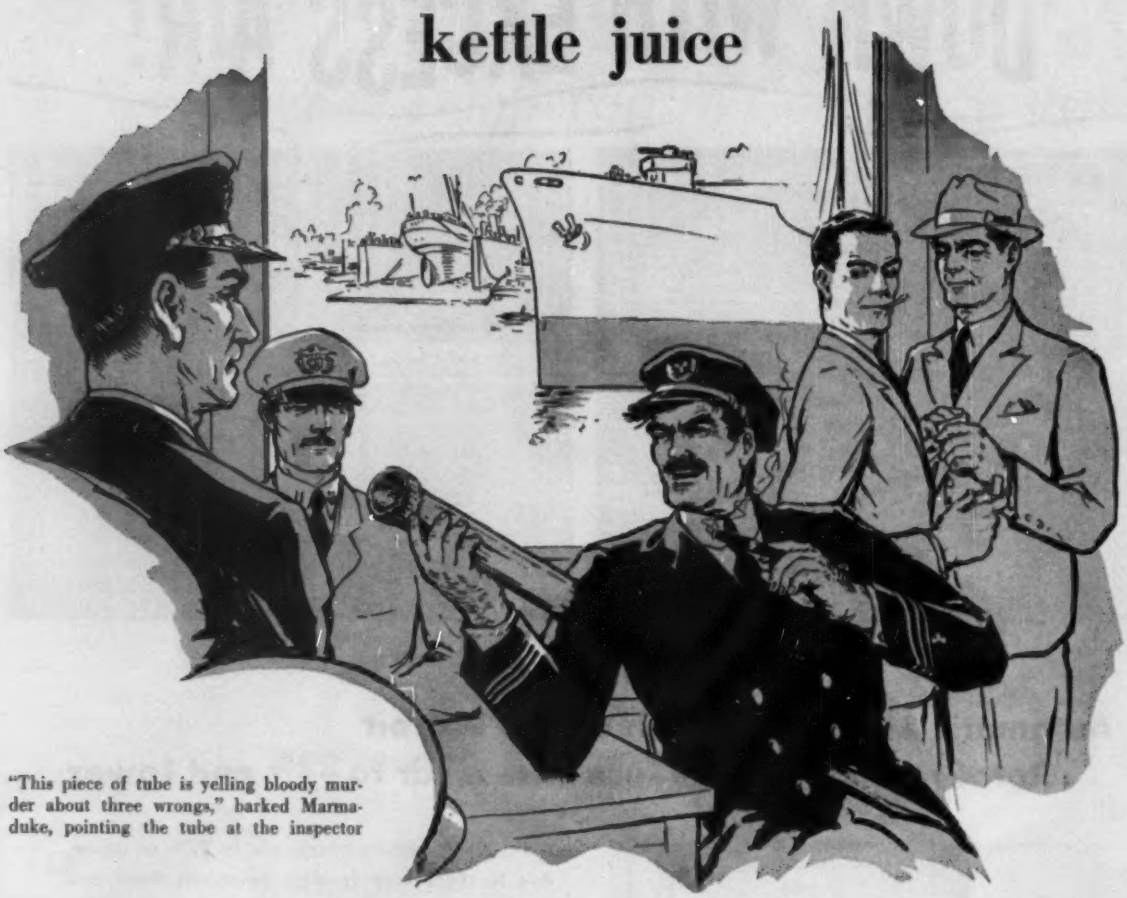
For more facts circle 296 on Reader Service card, p 103

Marmy's vanishing kettle juice



"This piece of tube is yelling bloody murder about three wrongs," barked Marmaduke, pointing the tube at the inspector

"BILGEWATER on air polluters," roared Marmaduke Surfaceblow while I was at the Bent Propeller Bar today. "I'll tell you boiler-house bankrupters how I got a convoy to sail on time during World War II and all I did was read the message that one of her ships' boilers spelled out in capital letters."

What caused the old consultant to burst out like this? Don't ask me. I had just dropped into that waterfront hangout hoping to hear him sound off about something I could get into this issue. And I was in luck.

Soon as Marmy had everyone's undivided attention after that explosion, he hooked his thumbs into the armpits of his checkered vest, turned towards his audience, then blasted away in his foghorn voice.

"Back in 1942 I was chief engineer of the freighter *SS Plymouth*. After returning from a Murmansk run that June, we limped into the Newport News Shipyard for repairs. Out of an 82-ship convoy, only 39 of us got back that trip. The German submarines started knocking us off like sitting ducks soon as we poked our bows outside the Narrows from the port of New York. Then a hungry wolf pack of subs hung onto our tail, torpedoing the devil out of us all the way to the coast of Ireland.

"Skirting Finland we sent up barrage balloons, anchored to our decks by steel cables. That kept the Stukas from flying too low. But they kept bombing us all along the Finnish coast. Finally we dropped anchor in Murmansk, unloaded and started back, getting more of the same treatment only in reverse. That was the so-called 'Phony War,' when the merchant marine took it on the chin alone and couldn't do a thing about it.

"Most of the ships left afloat from that convoy carried some nasty scars and the *Plymouth* was in for her share of plastic surgery. Next morning after drydocking at Newport News, I was sitting in the yard office of the American Bureau of Shipping. After that nightmare of a trip it felt mighty good to be alive as I sat there puffing on a cigar and sipping a cup of black coffee.

"While I was batting the breeze with the ABS surveyor, his phone rang. 'No, Sir, we still don't know where all that extra feed goes. No, Sir, we have no new theories. Yes, Sir, I know the convoy may be held up. Doing everything we can, Sir,' he answered smartly, then hung up.

"While he was yapping I noticed a piece of boiler tube

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on the table. I picked it up and gave it the eagle eye. 'That's the cause of our biggest headache right now,' said the inspector, turning to me. 'That tube was yanked out of the *SS Lightfoot's* sinuous-header type boiler. Unless we unravel that mystery, and soon, she'll hold up a critical convoy. They already have her loaded with top-priority cargo, so we've got to get her back into circulation.'

"'I've sailed with kettles of the *Lightfoot's* class,' I told the inspector as I examined the tube. Then I squinted closer at that hunk of innocent-looking metal and really got interested.

"'I'm as surprised as a mermaid seeing her first sailor,' I piped up, getting a brainstorm. 'Those boilers were the best shipmates I ever had. Can't savvy why the kettle this tube belonged to should be throwing you boys blinding curves.'

"The surveyor told me that the tube section had been cut out of the boiler's rear header that morning, for a look-see. Trouble had been nailed down as excessive leakage at the tube ends where they were rolled into the headers. Only none of the smart boys knew why, or how to stop those tube ends from acting like a spouting whale.

"According to the inspector, the ship had just completed her maiden voyage. That was a short trip across the Atlantic to Casablanca in convoy. Trouble started after the ship was out a couple of days. Suddenly the boilers started drinking makeup water like crazy. A few days later they were screaming for extra feed.

"The engineers ran around, tearing their hair while checking their plant: boilers, condensers, feed pumps—everything they suspected. Finally they zeroed in on tube leakage as the cause. One boiler was cut out, cooled and gone over with a fine-tooth comb. But they couldn't find any evidence of leakage.

"They filled that kettle right up to her air cock, then gave her a hydrostatic test. But her tube ends didn't even weep. Yet, the white steamy vapor did stop coming out of the ship's smokestack during this time.

continued

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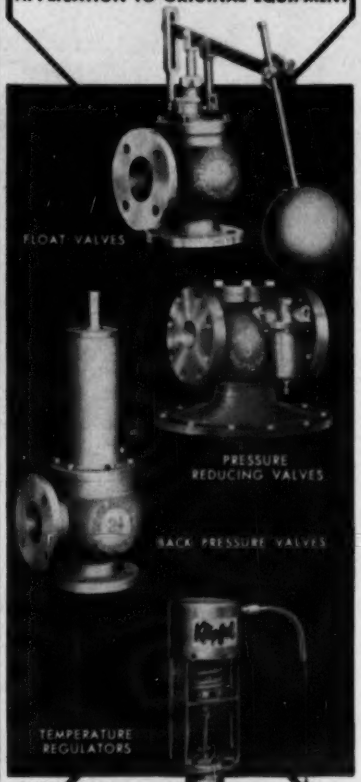

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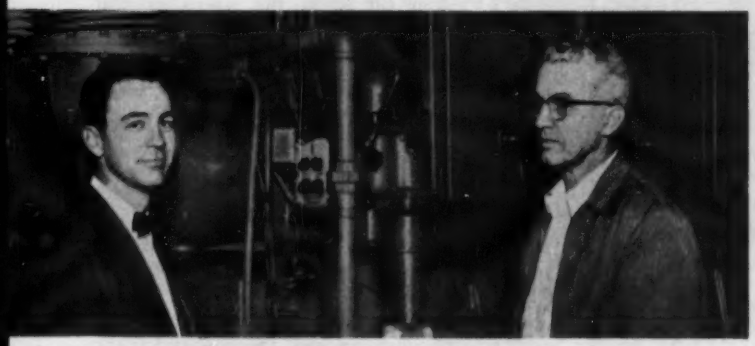
Want minimum maintenance on a dual-fuel engine? —STANODIESEL Oil M

Stafford, Kansas Light Plant finds this lubricant helps hold down maintenance and operating expense



Bill Ray, (left), Standard Oil lubrication specialist calls on Stafford city superintendent LeRoy Priess. Rendering technical assistance to customers such as this is Bill's job. He is qualified for it through seven years' service with Standard Oil Company. Bill is a graduate of Wichita University.

Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
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- Maintains film on difficult-to-lubricate parts.
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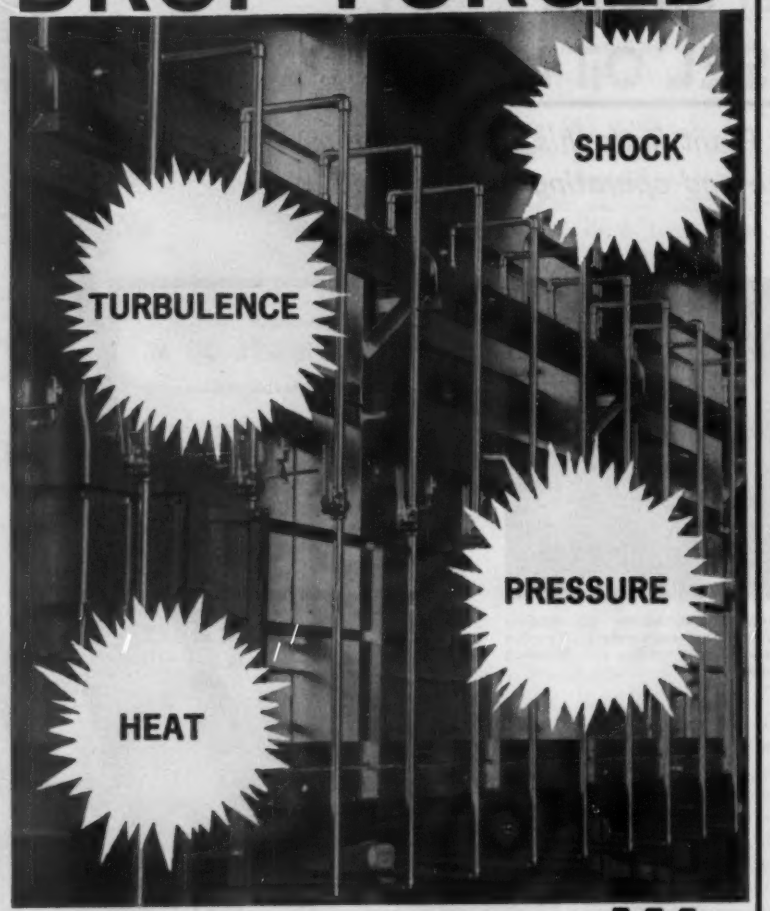

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For more facts circle 301 on Reader Service card, p 103

Marmaduke

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So again she was fired and put on the line, but after a few days the makeup water consumption hit high C. Out came the boiler again. There was no question about that boiler leaking because makeup-water consumption settled down to normal with her cut out. And no more vapor from the stack. But where was the water gushing from?

"This time the boiler was kept off the line until the *Lightfoot* pulled into Casablanca. There all her tubes were rerolled and the boiler hydrostatically tested. But she was leaktight—still. So back on the line she went.

When the convoy left Casablanca the makeup water was down to a respectable level—for the first two days. Then up she shot again, and just as high as before. But that time, instead of playing games, the chief requested permission from the convoy commander to cut her out and steam along on one boiler.

"The *Lightfoot* tied up in Newport News a week before we limped in. Then it was the yard staff's turn to lose sleep. The boiler manufacturer's service engineer was called in, the American Bureau of Shipping surveyor, the U.S. Maritime Service engineers and everyone else who knew anything about untamed boilers. Finding a boiler leak that sprayed out all that water looked like duck soup to the experts, so they gave the green light on loading the ship.

"But after a whole week, no one could put his flipper on the cause. By then red faces were turning purple. Because the ship was delayed, a headquarters boiler expert from the U.S. Maritime Commission in Washington flew up. Two more days of conferences, but no soap.

"Just as the ABS surveyor got through briefing me, some worried-looking men shuffled into the office from the conference room. The U.S.M.S. inspector was questioning the ship's chief engineer.

" 'I'll stick my oar into your troubled water, because I'm in this war, too,' I said, pointing the piece of tubing at him. 'I've sailed with these kettles so I know them like a mother knows her own brats. The answer you boys are looking for is stamped right here on this piece of

★ **MEMPHIS** . . . As a member of the Alsonett chain of hotels, Hotel King Cotton serves Western Tennessee with its 200 guest rooms and complete banquet facilities. MOGUL is used in treating the hotel's cooling tower and boiler systems.

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boiler tube. To me the message is as clear as the smile of a Tahitian maiden. Fact is, I'm willing to bet a case of Sandpaper Gin that I'm right.'

"'I think you're full of fish oil,' said the ABS inspector disgustedly, but he started bombarding me with questions.

"'This piece of tube is yelling bloody murder about three wrongs,' I gulped. 'First, it shows evidence of leakage. Second, it's screaming about movement between the header and tube. And third, it's crying about being over-rolled.'

"'I'll buy some of that,' groaned the U.S.M.S. inspector hopelessly, 'but that boiler still didn't leak a drop while under hydrostatic pressure. She only leaked while steaming in convoy. How do you add that up on your abacus?'

"'How can you experts be so fog bound?' I inquired as diplomatically as I could. 'The leakage while under way is due to movement between tubes and headers. That's from the continual temperature changes caused by fluctuating steam requirements under convoy conditions.

"'I've been shipmates with these boilers long enough to find out I could operate on one boiler when we kept varying the fires while sailing at speeds way below those needed for maximum boiler capacity. But that was only when convoy regulations would allow such a procedure, of course.'

"'OK, I know all that,' rasped the U.S.M.S. inspector impatiently, 'please get to the point.'

"'Well,' I continued, 'Leakage comes from the tubes' rolled ends moving excessively in the headers. And that movement is caused by expansion and contraction.'

"'All right, all right,' cut in the irked inspector. 'I follow you, but that can't happen with this boiler design. The rear header is free to move with the tubes as they expand and contract. Hell, there's nothing restricting either of them. So how do you explain the movement between the tube and header?'

"'Simple as spending money the first night ashore,' I laughed. 'The headers have either been welded to

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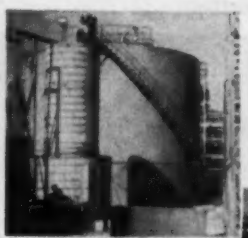

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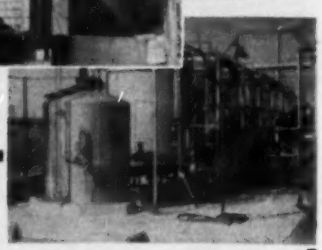

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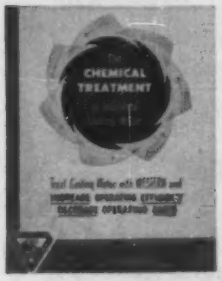

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Marmaduke

Begins on page 158

the supporting structure or they are braced in some way so they aren't free to move. That means the only movement that can take place is between the rolled end of the tube and tube sheet. It's engraved right here on this tube, screaming at you guys to listen. There *is* movement here, so the only question is why. All you have to do is examine the boiler to find out.'

" 'Well I'll be a cross-eyed octopus,' grunted the inspector, coming to life. 'We checked that boiler for everything but the gill and flipper disease—but maybe she has that. So let's take another look-see.' With that, they shoved off for the *SS Lightfoot* at the next dock.

"Half an hour later they were back. 'Well, Chief, you win the ruptured albatross,' rasped the inspector, barging into the room. 'And what do you think? Some fishhead did weld that header to its supporting structure, just as you diagnosed it. Why he welded only one of those two boilers is another mystery. I've given orders to have the welds chipped out. She can sail with the convoy on time.'

"I'm sure glad we can forget about the *Lightfoot*,' piped up the ABS surveyor, shoving a handful of cigars into my pocket.

" 'Soon as I get to Washington I'll send a directive to all shipyards warning them about bracing those headers,' said the U.S.M.S. inspector. Then after a few seconds he added, 'Say, how about dinner with me and some of the boys here at the Officers' Club tonight? I can't get a plane out for Washington before morning. Besides, you merchant mariners are taking it on the chin, so maybe I'll even dig up a case of Sandpaper Gin to lubricate your tubes while in port.'

" 'No, thanks,' I said. 'I'm flying up to Boston at noon. I have a lobster-dinner date tonight at Locke-Ober's on Winter St with my old shipmate Cy Hansen. I may even look over the lovelies on Scollay Square afterwards. Then tomorrow I report to the Quincy shipyard for a new assignment.' With that I heaved anchor from the swivel chair and shoved off."

—*SME*

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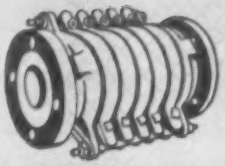

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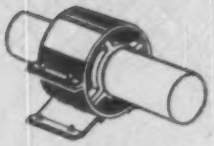

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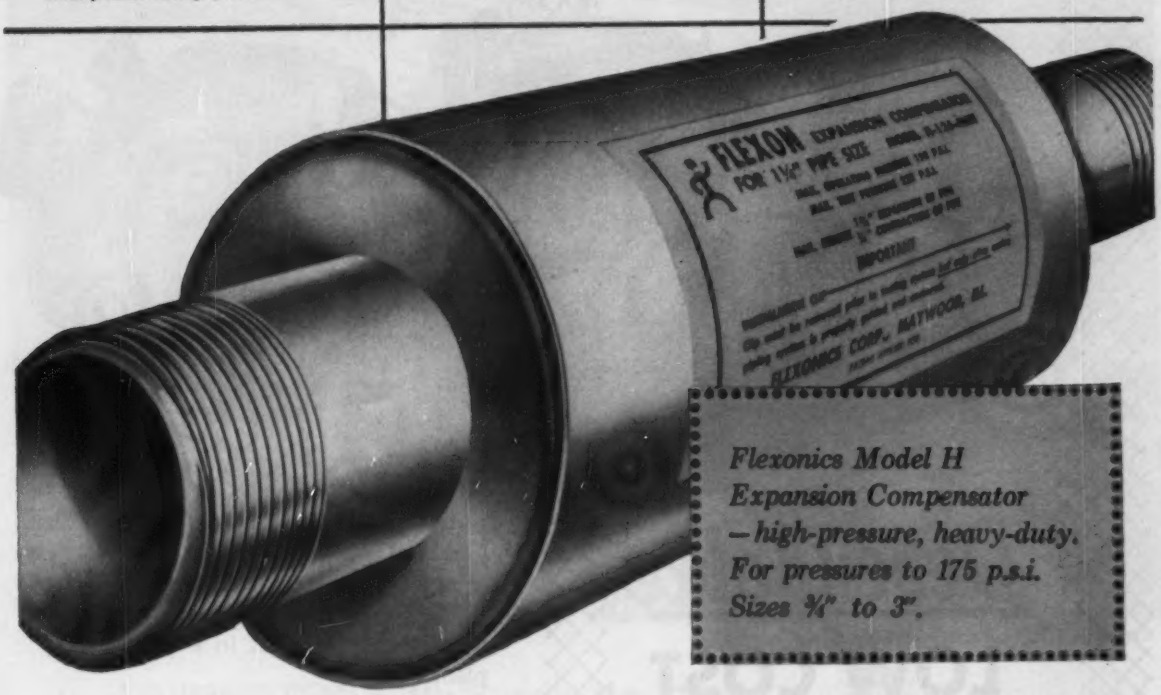

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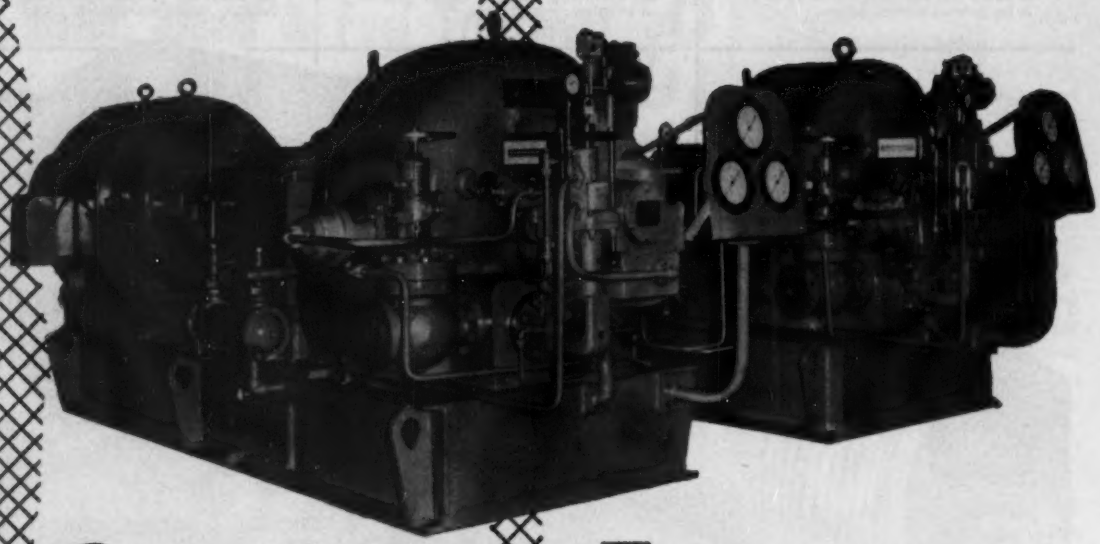

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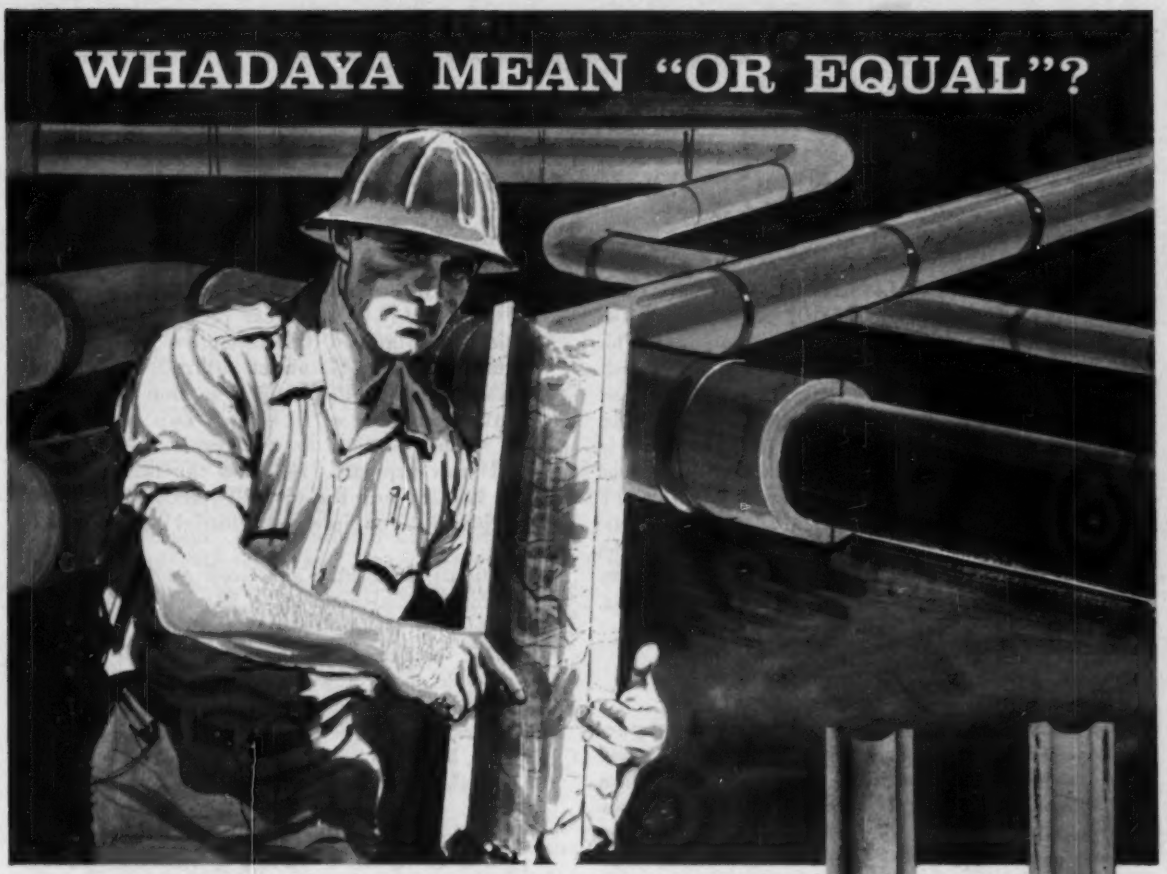
For more facts circle 308 on Reader Service card, p 103

WHADAYA MEAN "OR EQUAL"?



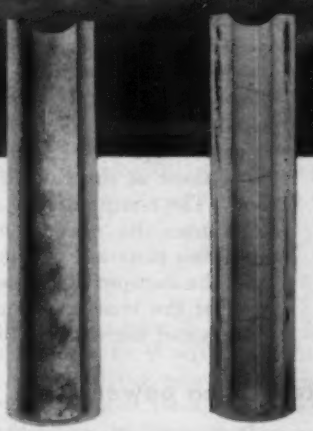
UNIBESTOS... No-Shrink, No-Shock!

No matter how carefully specifications are worked out, the term *"or equal"* can mean trouble . . . big trouble. Take insulation shrinkage and shock for example. Hard to predict, hard to account for, they mean heat loss and replacement that can put a serious crimp in any profit picture.

That's the very reason why Unibestos *"no-shrink," "no-shock"* insulation is worth more to you. Yet it sells at competitive prices. Prove to yourself how Unibestos saves you money by eliminating shrinkage, breakage, and thermal shock. See how it defies fumes, acids and moisture; cuts application time and cost, and guarantees real insulating efficiency.

Available in a full range of standard pipe sizes and in block form. Single thicknesses to five inches. Specials to 44" O.D. in half sections.

Write today, on your letterhead, for Bulletin No. 65610.



UNIBESTOS AMOSITE INSULATION | **ORDINARY ASBESTOS INSULATION**

What's the answer to Unibestos superiority? It's the extra-long fibered *Amosite* asbestos, plus an exclusive manufacturing process that assures top insulating efficiency *plus* high mechanical strength. In use month after month, year after year, you'll have no shrinkage problem, as Unibestos goes on and on.

UNIBESTOS

worth more, yet sold at competitive prices

UNARCO®

UNARCO PRODUCTS

• UNIBESTOS, Amosite Asbestos Pipe Covering and Block • Calcium Silicate Pipe Covering and Block • 85% Magnesia Pipe Covering and Block • Mineral Fiber Block • Wrap-On Insulation • Lace-On Insulation • Turbine Blankets • Insulating and Finishing Cements • Asbestos Textiles • Packing and Gasketing.

UNION ASBESTOS AND RUBBER COMPANY • FIBROUS PRODUCTS DIVISION

DEPT. 215, Bloomington, Illinois

For more facts circle 309 on Reader Service card, p 103

Powerscope . . . A selective look at

From seconds to minutes

Tremendous push that direct conversion of heat to electricity is getting has been demonstrated by Westinghouse Research Laboratories. They have run a magnetohydrodynamic (MHD) generator for four minutes to produce 2.5 kw of electric power. This compares with runs counted in seconds previously reported for lower-power units. The generator, see p 71, has a gas-flow cross section of 1⅝ by 4⅞ in. and is 16-in. long. Gas made by burning oil in oxygen flows at a rate of 1.1 lb per sec with a speed of about 2000 mph, a temperature of about 4600 F and 15-psig pressure through a strong magnetic field. Potassium soap mixed with the oil provides the free electrons for electric-current production. Water cools the generator's side walls of zirconia. Run duration is limited by melting of parts.

More automation

Two more utility plants will use general-purpose computers built by Daystrom Inc; one is the Darlington, N. C. plant of the Carolina Power and Light Co and the other Willow Glen of Gulf States Utilities. Each computer monitors up to 400 points in the station, scanning these at the rate of five points per second. The computers do all arithmetic to give operators the needed numbers. Whenever anything runs out of range an alarm sounds and the computer prints out time and location of the trouble. Once an hour the computers can log up to 220 variables.

Red China powers up

(McGraw-Hill World News) During 1959 Red China added 4700 mw in thermal plants and 1300 mw in hydro. About 1600 mw was installed as 50- to 100-mw plants built by Soviet Russia and installed under their direction. In 1960 Red China plans to install the first 100-mw unit of its own manufacture. Of the 50-mw units installed last year, 60% were homemade, the rest came from U.S.S.R., Czechoslovakia and East Germany.

India industrializes

(McGraw-Hill World News) The Roukela steel works in India built by Siemens of West Germany will have its own 75-mw power plant. Plant has three turbine-generators, four turbine blowers. It will be fueled by coke-oven gas, tar oil, coke breeze and blast-furnace gas, all byproducts of the steel mill. The million-ton mill will start full production in early 1961—it will be the largest in India.

Far Northern power plants

Ontario Hydroelectric Commission of Canada announced plans to install three hydro plants in the James Bay watershed area, south of Hudson Bay. The 6-year program will build the first plant on the Mattagami River at Little Long Rapids, about 40 miles north of Kapuskasing. Plant starts in late 1963 with initial capacity of 114 mw. Two years later a second station down-river will start with 110-mw capacity. In 1966 the third station at Lower Long Rapids will start with 132-mw capacity to complete the initial program.

National Aeronautics and Space Administration is opening negotiations on an $8-million contract to develop a nuclear-powered generating plant for space vehicles. Weighing 1500 lb, system would generate about 30 kw and run a year. The plant is expected to be ready in about five years. It will be designed to power the auxiliaries in a space vehicle, but could also provide propulsive power once the vehicle is lofted into an orbit around the earth.

(McGraw-Hill World News) **U.S.S.R. has plans to install a 12-mw geothermal power plant in Paushetski on the Kamachatka Peninsula. Twelve wells will be drilled to depths of 300 to 1000 ft to bring up steam-water mixtures at 250 F and 50 psig. Separators will dry steam before it enters turbines.**

A new society

The Fluid Power Society, a new technical organization, has been formed to disseminate knowledge of fluid power. It was formed by collaboration of the National Fluid Power Association and the Industrial Hydraulics Training Association. Memberships will be on individual basis and the Society will carry on through local chapters. For information write Barrett Rogers, Executive Vice-President, National Fluid Power Association, 5595 North Hollywood Ave, Milwaukee 17, Wis.

World's longest air receiver

Arnold Engineering Development Center at Tullahoma, Tenn. has an air receiver 720-ft long and three ft in diameter. It holds 100,000 lb of air at 4000 psig to supply nine test tunnels. Air must be dry and free of oil when used in the tests. To meet this requirement Cooper-Bessemer built a multistage compressor with special unlubricated carbon pistons and piston rings. The reciprocating compres-

this month's power-field happenings

B G A SKROTZKI, Associate Editor

sor runs about 20 hr per day at 360 rpm. It has five stages with water separators and coolers between stages.

The Westinghouse gas turbine at Bonne Terre, Mo., driving a compressor of the Mississippi River Fuel Corp, has racked up a record 60,000 hr of operation—probably the longest service record of any industrial gas turbine.

Power from the sun

A 1912 Baker electric automobile "powered by the sun" was exhibited at the American Power Conference in Chicago, Ill. Car has 10,000 silicon solar cells mounted on its roof in a detachable 26-sq-ft panel. These cells charge the 72-volt battery system which drives the car. Want to buy one? Solar-cell panel cost $15,000 — but mass production will bring this down to about $2000 or $3000.

Pushbutton nursing

Hospital nurses can now check the temperatures of their patients by simply flicking a switch in the nurse's office. An invention of a British doctor at Edinburgh University, this system is now operating in a 6-bed ward at the Edinburgh Royal Infirmary. Electronic thermometers work with transistors and small batteries. Each consists of a highly sensitive thermistor. Heat changes the resistance of the metallic-oxide tips; changes register on the meters. Thermometers can be strapped to the patients and easily wired to central metering board in the nurse's office for quick and accurate readings.

Plastic coatings are expected to lengthen the life of condenser waterboxes. Allis-Chalmers has applied a 1/16-in. epoxy-resin coating on these parts for an 18,000-sq-ft condenser for the 450-mw unit at Philip Sporn Plant. The welded-tube condenser serves a boiler-feed turbine. Other units are also being coated.

Most powerful pump turbines

English Electric Company has the contract to build three 108,000-hp pump turbines for two new Spanish power stations. Total output of the two stations will be 400 mw. Delivery begins in 1961.

Ductile iron is finding increasing use in the structure of large electric generators. The nonmagnetic properties of ductile iron are on a par with stainless steel, but higher resistivity of the iron reduces eddy-current losses. Ductile iron can be easily cast, where stainless steel would need complicated welding and machining. The iron has good corrosion resistance and is extremely easy to machine.

Superheat to save

A study carried out by General Electric engineers in their Atomic Power Equipment Dept showed that large nuclear-power units could save about 0.7 mill per kwhr with superheating. This is a sizable percentage of costs estimated at ranging from 7.5 to 8.5 mills per kwhr, could prove out in high-fuel-cost areas.

What price education?

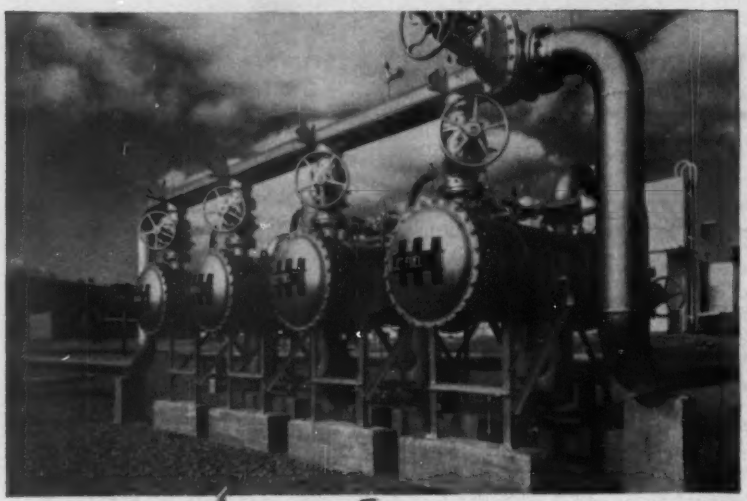
In a talk before the ASME, Glenn Warren, VP of General Electric Co, said, "Perhaps we may have to choose between education and certain other things. We spend about $16-billion yearly on educating the oncoming generation. This is only about 4% of our national income. We spend almost as much on tobacco and liquor, twice as much on our motorcars —not counting the roads. We spend almost this amount on our television, radio and motion-picture amusements. I have no quarrel with any of these. I think we can have them and enough for education too. If not, it is a matter of choice as to what is most worth while."

World Power Conference

The World Power Conference to be held in Madrid, Spain, June 5 to 9 will have the theme, "Methods for solving power-shortage problems." Topics planned for the five sections are: (1) Methods of investigating energy sources and requirements (2) efficiency of production and utilization of energy (3) technical developments in transportation (4) establishment of nuclear reactors on an industrial scale (5) functional interrelation between conventional and nuclear production of energy. Conference includes a number of social events and six post-conference tours.

An item for your library

The AEC's report, *Radioisotopes in Science and Industry*, summarizes its development program in this area. It cites uses in agriculture and plant studies, medical therapy and diagnosis, physical and chemical research; development of new applications; training and safety programs in the use of isotopes. Copies of the report can be bought from the Superintendent of Documents, Government Printing Office, Washington 25, D.C. for $1.25.



Markowitz Bros. Inc., Mechanical Contractors
Miami, Florida

on the military pipeline in spain...

WELDOLETS were used for all branch connections on pumping station piping

Reinforced branch connections constructed with Weldolet Welding Fittings provide assurance of quality workmanship at the critical branch connection.

Savings in purchase price and construction on this project alone were high in the six figures. Piping designers and contractors who are interested in similar savings on their jobs are invited to write us for the Bonney Spanish Pipeline Brochure.

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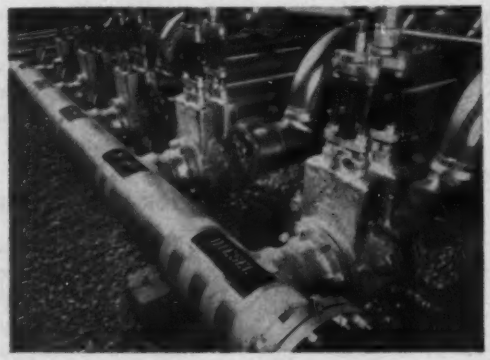
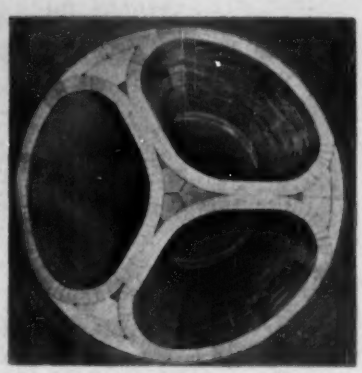
for all services



BONNEY FORGE and TOOL WORKS
ALLENTOWN, PENNSYLVANIA

Reports from the field



Trefoil refractory heat exchanger sees 3 yrs service

Harbison-Walker Refractories Company have developed a trefoil refractory heat-exchanger design for rotary- and lime-sludge kilns. An early installation in a 10-ft kiln has already been in service for three years.

Preheated charge passing through the trefoil tends to moderate temperature in the hottest zone. Development of excessive accretions in high-temperature zones with certain fuels may be reduced, stretching lining life.

Video-guard monitors luxury apartment house

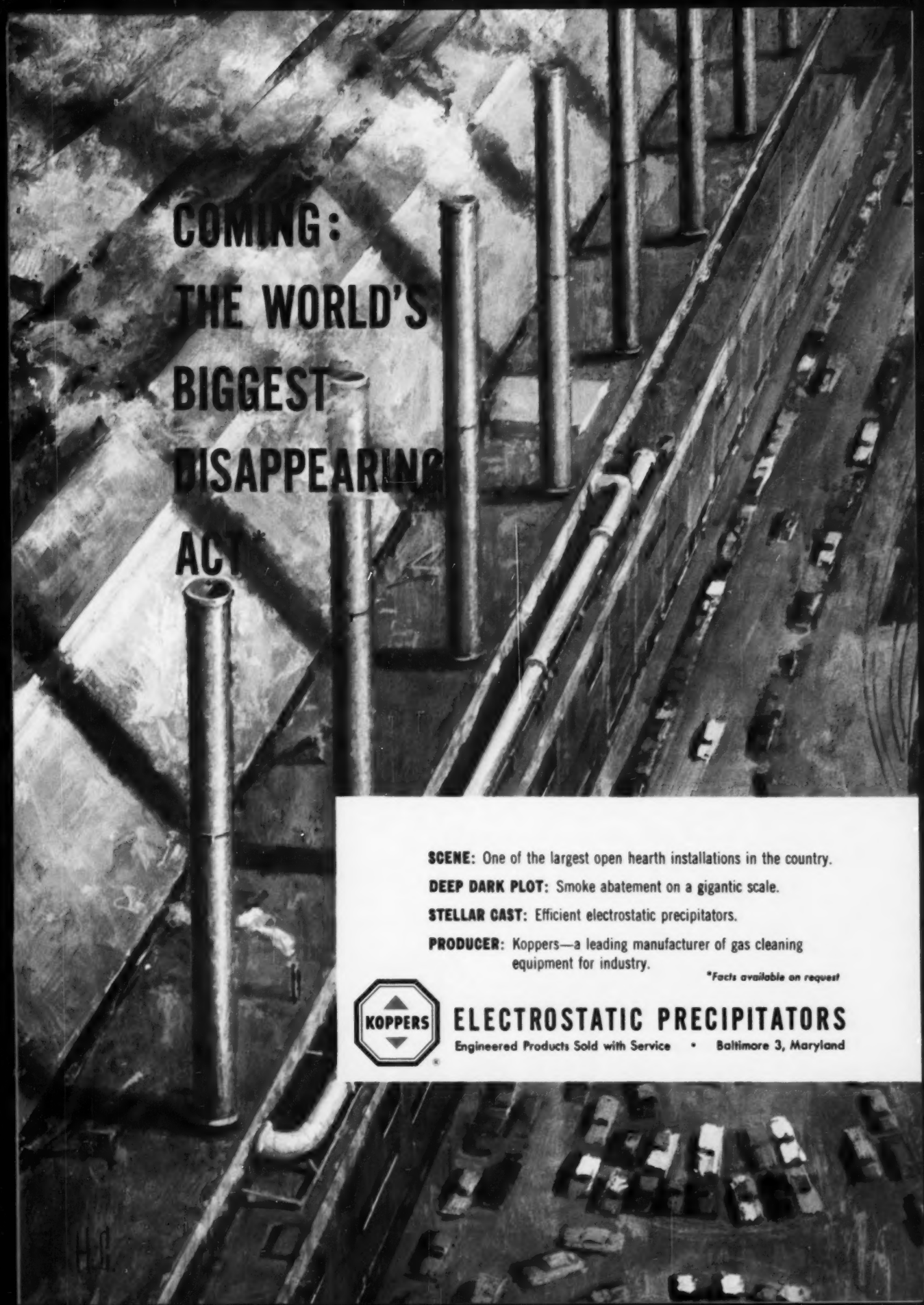
Tenants in a new Second Ave apartment house in New York City are observed on a closed-circuit television screen as they ride the automatic elevators. A television console in the apartment-house lobby has two 21-in. screens. One shows the interior of the elevator; the other monitors a well-lighted service entrance in the basement. The doorman can talk over a 2-way radio with persons at both sites. By pressing a button on the console he releases the lock in the basement door.

System was installed to offer tenants greater protection. According to Martin Sugar, President of Bell Television, Inc, it is the first security of its kind to be installed in a New York City apartment house. He estimated cost at no more than $6500.

continued

For more facts circle 310 on Reader Service card, p 103

circle 311 on Reader Service card, p 103 ▶



SCENE: One of the largest open hearth installations in the country.

DEEP DARK PLOT: Smoke abatement on a gigantic scale.

STELLAR CAST: Efficient electrostatic precipitators.

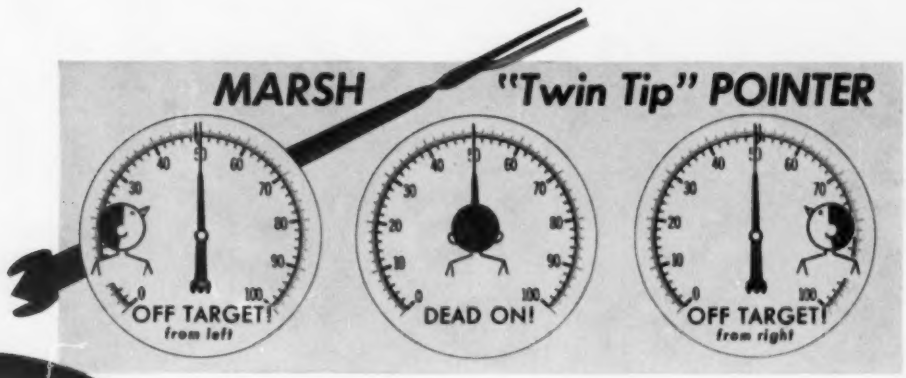
PRODUCER: Koppers—a leading manufacturer of gas cleaning equipment for industry.

**Facts available on request*

KOPPERS

ELECTROSTATIC PRECIPITATORS

Engineered Products Sold with Service • Baltimore 3, Maryland



Now *reading accuracy* in keeping with *instrument accuracy*

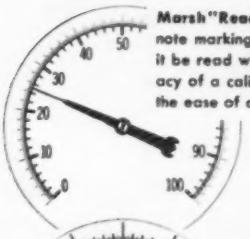
The development of the "Master-test" series brought industry pressure gauges of almost incredible precision ... gauges individually dead-weight tested ... gauges guaranteed accurate within ¼ of 1% of full scale reading.

But this extreme accuracy would have been meaningless unless the gauge could be *read accurately*—unless some means were provided for sighting the scale "dead on."

That was the reason for developing the "Twin-tip" pointer illustrated here. With the "Twin-tip" there is no excuse for wrong reading. If two tips are showing you're "off." If only one tip is showing you're dead on the target. It's as simple as that.

The Twin-tip has been declared a real innovation by all who have seen it. In addition to the "Twin-tip", "Master-test" gauges are also available with a Mirror Scale or with a "Non-parallax" scale which also provide reading accuracy in keeping with gauge accuracy. To make reading still easier all "Master-test" gauges have the "Read-easy" scale, illustrated opposite—another Marsh development.

"Master-test" gauges are made in sizes 4½", 6", 8". All standard ranges from 0-15 to 0-30,000 psi. Vacuum and compound types. Full range of case patterns.



Marsh "Read-Easy" Dial note markings that permit it be read with the accuracy of a caliper, yet with the ease of a clock.

Conventional Dial markings are crowded in—hard to read.

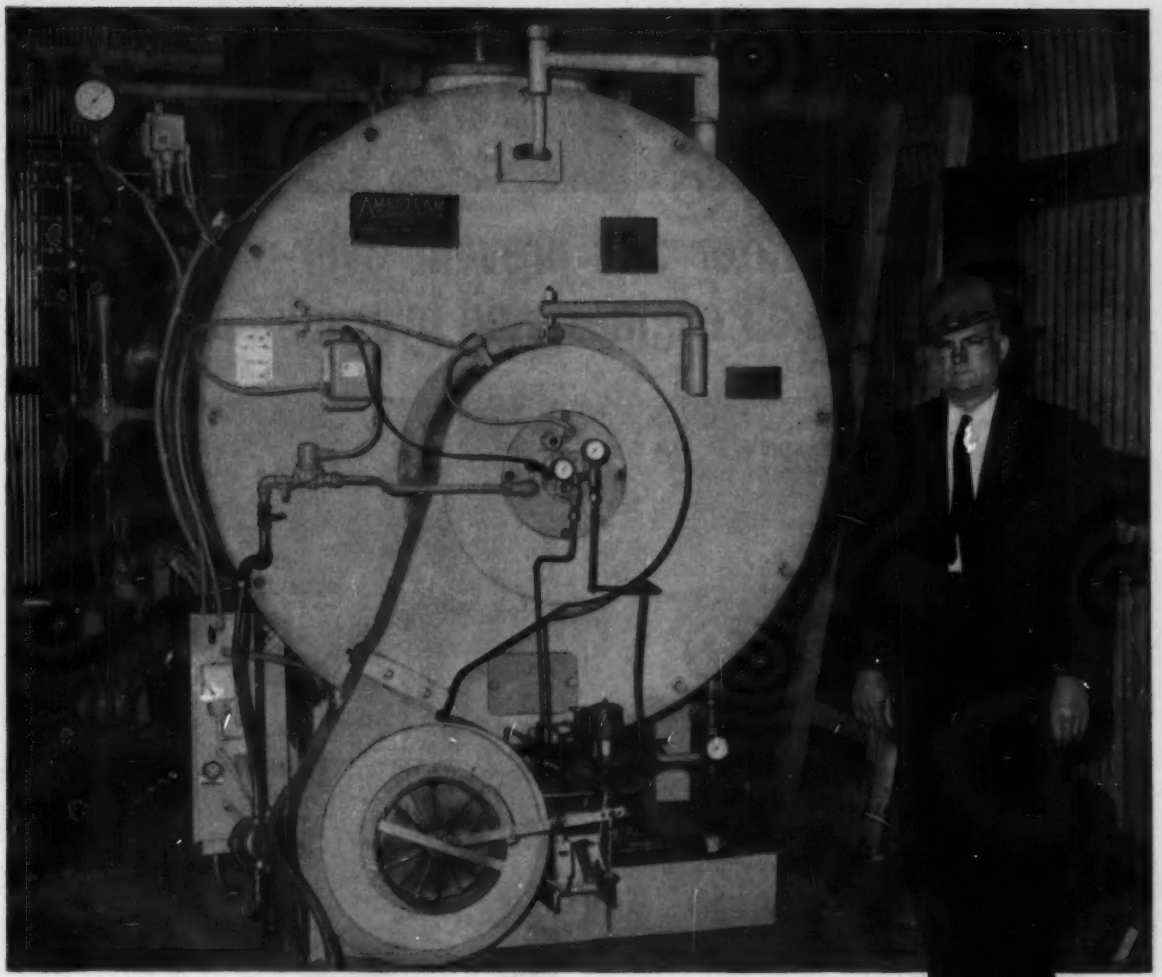
Ask for this 20 page bulletin

MARSH

"THE STANDARD OF ACCURACY"

MARSH INSTRUMENT COMPANY, Dept. F, Skokie, Ill.
Division of Colorado Oil and Gas Corporation
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant, 1121 Rothwell St., Sect. 15, Houston, Texas

For more facts circle 312 on Reader Service card, p 103



"We are well pleased with the 150 HP Amesteam Boiler we purchased from you," states C. W. Gearner, owner of Texas Creosoting Pole & Post, shown here with his Model AA Amesteam Generator, operating on $285 fuel cost per month as against $910 with the former boiler.

SAVING $625.00 A MONTH ON FUEL

...WITH THE NEW MODEL AA AMESTEAM GENERATOR

You can't argue with figures. This dramatic fuel saving enjoyed by *Texas Creosoting Pole & Post Co.* by switching to Amesteam Generator amply illustrates our claim of "lower operating costs" for the new Model AA Amesteam Generator. As owner C. W. Gearner states, "... we were using a 110 HP oil field type boiler, and our fuel cost was approximately $910.00 a month. The fuel cost on the Amesteam is approximately $285.00 monthly." Mr. Gearner estimates that the *fuel savings alone* will pay for the unit in twenty months!

If you are interested in fuel economy like this — and economies all down the line — in short, *lower cost steam* — you'll want to mail the coupon below and find all about this totally new Amesteam Generator!

AMES IRON WORKS INC.
OSWEGO, NEW YORK

AMES IRON WORKS • Box H-50, Oswego, N. Y.

Gentlemen:—Please send me further information on AMESTEAM GENERATORS and name of nearest representative.

NAME_____

COMPANY_____

ADDRESS_____

For more facts circle 313 on Reader Service card, p 103

SARCO TOPICS

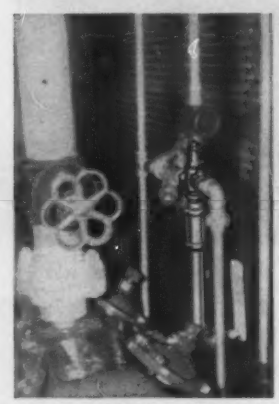
How to save water and prevent over-cooling of compressors, small engines, and hydraulic oil-coolers

When cooling water is controlled manually the operator frequently leaves the valve nearly wide open, in order to play safe if the load varies. The result is over-cooling. If he attempts to vary the flow of water he risks the danger of under-cooling. Automatic cooling controls assure proper cooling at *all* times and effect important economies in water consumption.

And here are three different experiences at Revere Copper and Brass plants which may give you some tips on solving your own cooling control problems.

T-44 cooling control on compressor at Rome Manufacturing Co. Div. of Revere. Sarco sales representative Emile Strickland points to control installations.

How Revere Copper & Brass Saved over 50% on water



Sarco T-44 automatic cooling control installed at Revere's Riverside plant.

The Riverside, California, plant of Revere Copper & Brass was plagued by over-cooling of compressors. In addition, their water consumption was high — approximately 2,000 gallons an hour. By simply installing Sarco T-44 automatic cooling controls on the compressor cooling lines, plant engineers eliminated over-cooling and cut water consumption about 60%.

Another benefit was a saving in tool maintenance. (Originally excess moisture was causing difficulty with a large number of air screwdrivers used in the plant.) With the T-44's in service the maintenance problem has practically disappeared.

Manual control was wasting water at Rome Manufacturing Co. Div., Rome, N. Y.

At the Rome Manufacturing Company Division of Revere, at Rome, N. Y., cooling water for air compressors originally was manually controlled. When they installed Sarco T-44 automatic cooling controls on the cooling water lines they made substantial savings in water. They saved damage and maintenance cost on the compressors, too. That's because they eliminated the errors inherent in manual control. Automatic cooling controls always assure optimum cooling by permitting safe operation at the maximum temperature recommended for any given machine or process.

Installation of a Sarco T-44 on compressor at Rome, N. Y.

Water conservation program at Baltimore led to automatic control

Double target of engineers at the Baltimore plant of Revere was a water conservation program plus tighter temperature control. To achieve both objectives they installed Sarco automatic cooling controls on an air compressor, an aftercooler and a hydraulic oil cooler.

Results were so satisfactory they followed through by installing 50 additional Sarco controls.

For more information on cooling control, contact your Sarco Sales Representative, District office, or write — 2169

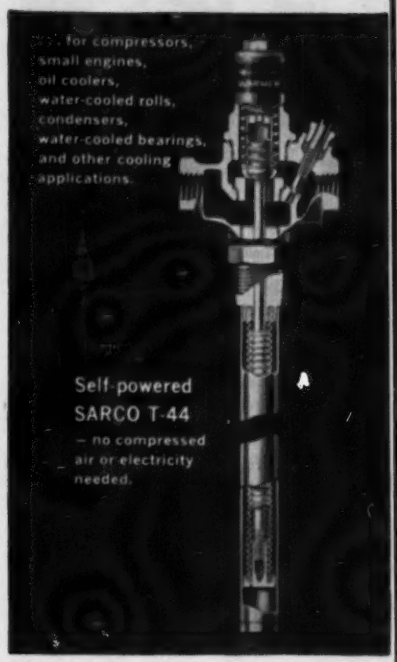
SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

SARCO

Inside story on automatic cooling control



Simple, gadget-free design. Fully modulating. Sensitive liquid-filled thermostat gives you uniform movement of valve for each degree of temperature change, at all points on the range. Packless — no stuffing box — no leaks — no valve stem jamming. Self-contained — no part of mechanism exposed. Dependable and inexpensive — thousands in service. So reasonable in cost, you can afford Sarco automatic cooling controls for every application.

Sarco T-44 self-powered cooling control is available in standard 50° adjustment ranges: 60-110° F., 85-135° F., 110-160° F. and 135-185° F. Sizes: ⅜", ¾", ½" and 1".

For the full story on Sarco Cooling Controls...

contact your Sarco sales representative or district office, or write—

2168

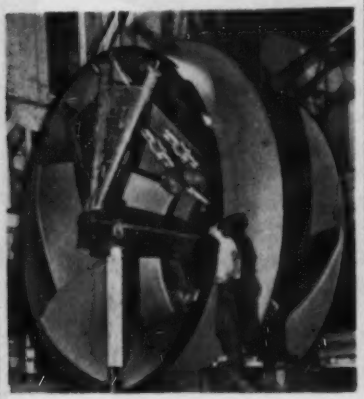
SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

Reports from the field

Begins on page 172

Tenants don't seem to mind being under surveillance. "Once you get over the fact that Big Brother is watching you, the safety factor is worth it," one tenant remarked.



Allis-Chalmers ships large Tuscarora runner

Shipment of this 50-ton runner completes the fourth reversible pump-turbine unit to roll out of Allis-Chalmers yards for the Tuscarora Pump-Power Plant at Niagara Falls. Firm will furnish total of 12 similar units for the project.

Ranked among the largest reversible pump-turbines ever built, units are rated 28,000 hp under a 75-ft net head as turbines, will deliver 3400 cfs against a dynamic head of 85 ft as pumps. Runner above was fabricated by welding the carbon-steel cast buckets to a cast crown and runner band. Stainless-steel segments are welded to lower parts of the buckets for protection against pitting.

Santa Susana Mts. is site of nuclear laboratory

The Santa Susana mountains near Los Angeles is the site of a new atomic facility being built for Southwest Atomic Energy Associates, a group of investor-owned utilities by Atomics International Div of North American Aviation, Inc. Expected to be completed this month, the facility will house a critical assembly ma-

PATHWAYS OF A PIONEER

ILLCO-WAY DESIGNERS AND BUILDERS

MODERN EQUIPMENT FOR ionXchange

This picture, taken in 1947, shows a fully-automatic IonXchanger designed and built by IWT.

Leading the Way in De-I Developments

At the time the IonXchanger shown above was installed, Illinois Water Treatment Company already had a decade of design and manufacturing experience behind it. Many other firms, now selling in the field, then had yet to cut their teeth on their first small jobs.

Ash from Corn Syrup

This particular job was especially important because it pioneered successfully in one of the many process fields — other than the purification of water — where de-ionization was proving practical. The equipment is still operating at full effectiveness today in the big sugar refinery where it serves most economically to remove ash from corn syrup.

It is significant that IWT had this early experience in the design of automatic equipment, and so was ready for the widespread trend toward "automation" in many industries in recent years.

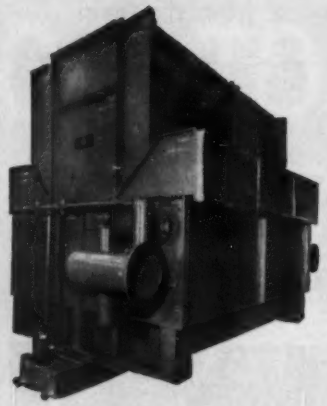
THIS EXPERIENCE CAN MEAN A LOT TO YOU

If you are considering the use of ion-exchange for the purification or concentration of chemical products, or if you need purified water for high-pressure boiler make-up or process use, be sure to take advantage of IWT pioneering experience and specialized knowledge.

Call your IWT representative.

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 131 E. 39th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

ECONOMICAL COOLING OF GASES AND COMPRESSED AIR



Cooling gases or cooling and removing moisture from compressed air, the Niagara *Aero* After Cooler offers the most economical and trustworthy method. Cooling by evaporation in a closed system, it brings the gas or compressed air to a point below the ambient temperature, effectively preventing further condensation of moisture in the air lines. It is a self-contained system, independent of any large cooling water supply, solving the problems of water supply and disposal.

Cooling-water savings and power-cost savings in operation return your equipment costs in less than two years. New sectional design reduces the first cost, saves you much money in freight, installation labor and upkeep. Niagara *Aero* After Cooler systems have proven most successful in large plant power and process installations and in air and gas liquefaction applications.

Write for Descriptive Bulletin 130.

NIAGARA BLOWER COMPANY

Dept. P-5, 405 Lexington Ave., New York 17, N.Y.

For more facts circle 317 on Reader Service card, p 103

SAFE
DEPENDABLE GENERATOR OPERATION
Spark Free!
EXPLOSION RESISTANT
KATO
Adaptable To Any Industrial Engine!
Kato's complete line of 50, 60 and 400 cycle revolving field AC Generators is now available in brushless design.
Especially desirable for operation in gaseous environments.
GREATLY REDUCED MAINTENANCE!

KATO BRUSHLESS AC GENERATORS

60 CYCLE SIZES

3 Phase: 5 to 400 KW **SPEEDS**
1 Phase: 5 to 150 KW 720, 900, 1200, 1800 RPM.

Take your choice throughout the Kato Line—Brushless or standard slip ring types. For all your 400 cycle or power converting needs investigate Kato's complete line of high frequency alternators and motor generator sets. Complete control systems for all Kato products include Kato magnetic amplifiers, voltage regulators, static exciters and motor starters for synchronous or induction motors.

NEW BRUSHLESS GENERATOR CATALOG
Write For It Today!

KATO ENGINEERING COMPANY

Builders of Fine Rotating Electrical Machinery Since 1928!

1479 FIRST AVE., MANKATO, MINN
PHONE 8-2941

Reports from the field

Begins on page 172

chine to study atomic-power reactor-core configurations and mechanisms. The project is part of Advanced Epithermal Thorium Reactor program which Atomics International is conducting for Southwest.

Turbo-electric station powers wind tunnel

Amsterdam *(McGraw-Hill World News)* A new wind tunnel for supersonic speeds has officially been put into operation at the National Aeronautic Research Institute in Amsterdam. Tunnel is one of the most important components of the lab's aerodynamic equipment. Power output required to set the air in motion is 20,000 hp, supplied by a turbo-electric power station.

The 406-ft long tunnel contains a small space in which wind velocity reaches about 930 mph, 1.3 times the velocity of sound.

Firms join to design computer systems

Republic Flow Meters Co and the Thompson-Ramo Wooldridge Products Co have agreed to design and furnish computer-operated systems for the electric power industry. The two companies will cooperate in engineering, installing and servicing complete valve, combustion-control, data-logging, alarm-scanning and computer-control systems to fill power-industry requirements.

According to Republic president W F Crawford, and TRW Products general manager Dr J F Manildi, the combined companies will provide a unique pool of knowledge and experience for planning automated power plants.

International Congress of Combustion Engines (CIMAC) will hold next congress at Copenhagen, Denmark in June 1962. Theme will be recent developments in diesel engines and gas turbines above 3000 hp. Details are available from: R L Stanley, Sec of U.S. National Committee, 2000 K St, NW, Wash. 6, D.C.

continued

THIS NEW BULLETIN

may bring you the answer to one of the commonest central station problems...

how to reduce boiler fan power requirements at reduced loads while maintaining high efficiency

If you are looking for places to plug power waste—boiler fans are good places to start. Without speed control, the fan pulls nearly the same power at low loads as it does at capacity, wasting salable kilowatts.

This new bulletin brings news of an answer to this problem—a variable speed hydraulic coupling. While input speed remains constant, output rpm can be easily, smoothly and quickly modulated over a wide range. Power consumption is thus proportioned to the draft requirements at all times.

The coupling has double-thrust bearings—low stressed shafting—improved shaft seals that stop oil vapor leakage—separate oil filters for the bearings—and a simplified, positive gear drive for the pump. In both design and manufacture, the primary emphasis has been on the complete durability and reliability that are imperative in central station equipment.

This bulletin is just off the press. If you would like a copy, drop a line to:

Industrial Products Division . . .

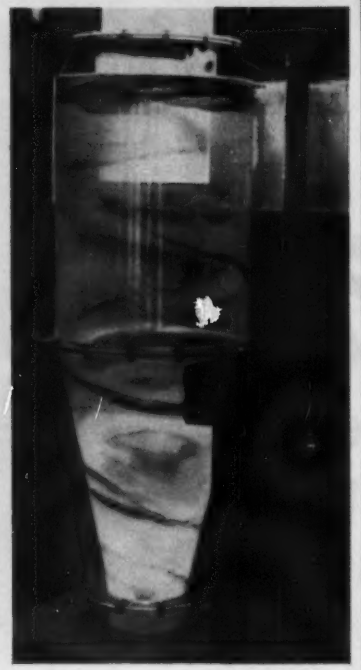
THE NATIONAL SUPPLY COMPANY

Two Gateway Center, Pittsburgh 22, Pennsylvania

Subsidiary of Armco Steel Corporation

UNRETOUCHED ACTION PHOTOS PROVE SUPERIOR PERFORMANCE OF BUELL CYCLONES

BUELL CYCLONE with Shave-Off



an ordinary cyclone

These are photographs of as true a test as can be made under laboratory conditions. Notice the difference in the dust patterns! In the Buell Cyclone, on the left, the dust at the top makes less than one revolution before it is trapped by the Shave-Off. It's then channeled down to the lower portion of the Cyclone, well below the clean gas outlet.

Why is the Buell Shave-Off so effective? Primarily because it harnesses the double-eddy current to convey the dust "fines" downward quickly, thereby promoting greatly increased efficiencies. In the ordinary cyclone, as shown on the right, these "fines" concentrate and recirculate at the top, causing erosion of the cyclone. To be collected, the fine dust must travel downward close to the clean gas outlet where much of it escapes. Buell Cyclones have made an impressive record in many years of trouble-free service. To see how their extra efficiency in the Shave-Off can pay off for you, send for our Cyclone Catalog #103. The Buell Engineering Co., Inc., 123 William Street, New York 38, New York. Northern Blower Division, 6404 Barberton Avenue, Cleveland, Ohio. (Subsidiary: Ambuco Ltd., London, England.)

buell Norblo

CYCLONES • ELECTRIC PRECIPITATORS • BAG COLLECTORS • COMBINATION SYSTEMS • FANS • CLASSIFIERS

Reports from the field

Begins on page 172

Back-to-school trek begins this month

Universities across the country are preparing for the influx of engineers and plant-management officials to their classrooms for summer seminar courses. A few worthwhile programs are:

May 23-27, Mathematics for operations research; May 31-June 10, Workshop in operations research; Sept 20-Jan 27, Development program in operations research—Case Institute of Technology.

June 1-3, 5th annual Appalachian underground corrosion short course including 54 classes and field demonstrations on public water systems, pipe coatings, instruments, special topics, both basic and advanced—West Virginia University.

June 12-17, Electrical precipitation; July 24-29, Research and management development; July 24-Aug 5, Atomic shelter; Sept 19-30, Technical report writing—Penn State U.

June 13-24, Introduction to digital-computer engineering; Programming concepts automata and adaptive systems—University of Michigan.

June 20-24, Gaillard seminar on standardization — Dr J Gaillard, American Standards Association.

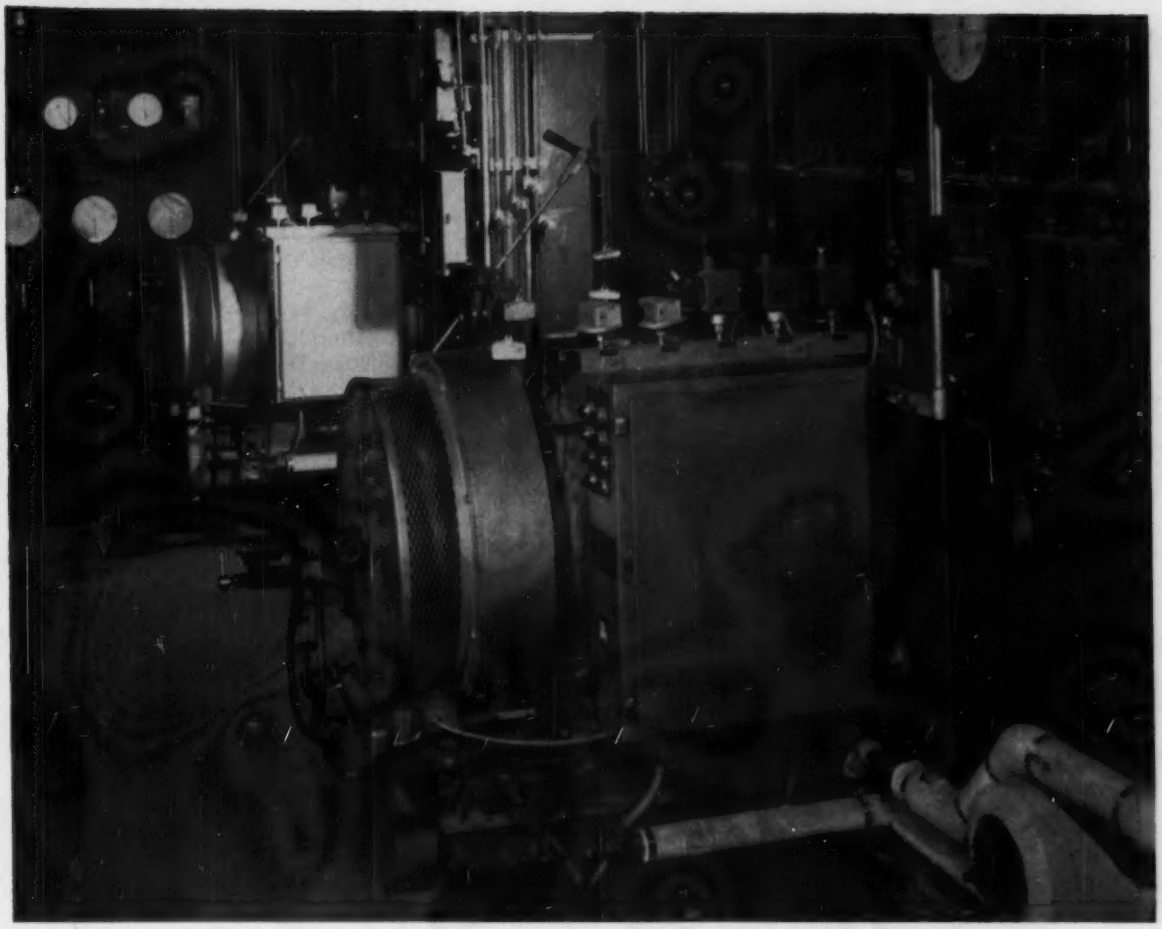
June 27-July 8, Modern developments in heat transfer—Mass. Institute of Technology.

For more information about these courses you can contact:

Case Institute of Tech—Dr E L Arnoff, Operations Research Group, University Circle, Cleveland 6, Ohio. **W. Va. University**—R E Hanna Jr, School of Mines, W. Va. U, Morgantown, W. Va.

Penn State U—Continuing Education Conference Center, University Park, Pa. **U of Mich.**— C Wixom, 3564 Adm Building, Ann Arbor, Mich. **Gaillard seminar** — Dr J Gaillard, 135 Old Palisade Rd, Fort Lee, N. J. **Massachusetts Institute of Tech**—J I Mattill, Cambridge 39, Mass.

Benmore, New Zealand power station will increase generating capacity to 540,000 kw—it will be largest single producing station in Southern hemisphere.



Two 25,000 pounds per hour steam generating units installed at Lafayette College, Easton, Penna.

FABER . . . INTRODUCES A **UNIQUELY DESIGNED COMPACT PACKAGE** OIL–GAS–OR COMBINATION BURNER FOR INDUSTRIAL AND COMMERCIAL USE

The Faber "AF" Packaged Burner built for rugged service — field tested over 5 years of continuous duty — offers these important advantages:

COMPACT Unique space-saving design integrates burner, blower and controls. All components accessible for inspection or maintenance.

EFFICIENT Specially designed axial flow, hollow shaft forced draft fan combined with adjustable curved vane air register and Voltrol fan inlet vanes provides efficient turbulent fuel-air mixture over wide ranges of operations for economical firing.

ADAPTABLE Fan unit and "V" belt drive may be altered after installation to accept heavier load for modest plant expansion with motor, turbine or combination motor-turbine drive as desired. Controls may be fully or semi-automatic or manual. Standard electric drive with oil immersed gears and heavy duty motor develops 100 ft pounds of torque. Hydraulic or pneumatic controls furnished where required.

SAFE Complete programming unit for flame safeguard, interlocked with safety circuit.

Write for Faber Catalog 59-1: **Faber Engineering Co., Inc.**
240 West Washington Street, Norristown, Penna.

FABER *ENGINEERING COMPANY, INC.*

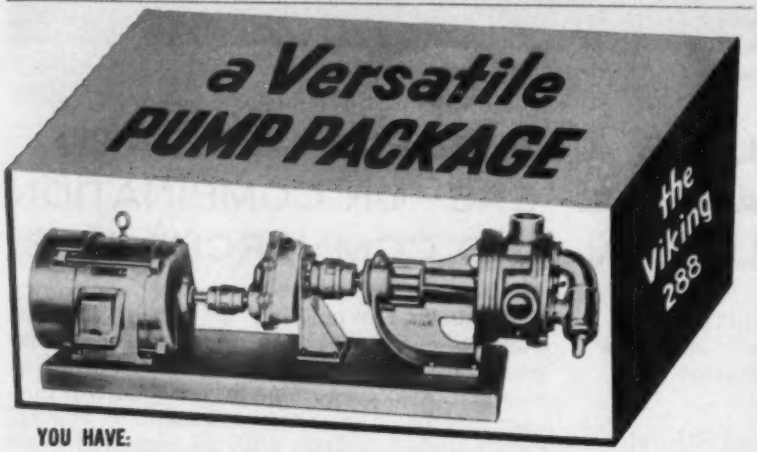
Manufacturers of Industrial Oil and Gas Burners, Fuel Oil Pump and Heater Units, Special Pumping Units, Since 1927 F-183

For more facts circle 321 on Reader Service card, p 103

Replacement Tubes

BOILER TUBE
COMPANY OF AMERICA
McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

For more facts circle 322 on Reader Service card, p 103



YOU HAVE:

- HEAVY DUTY, positve displacement pump construction with optional packing or mechanical seal.
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- SMOOTH, EVEN FLOW, fast self priming and extra long life — handling thin or thick liquids.
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- TOP CONSTRUCTION AND PERFORMANCE — Proved versatile. Meets rigid requirements in a wide variety of applications.

Send today for complete information. Ask for Catalog CW, pages 27-28.

VIKING PUMP COMPANY Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" Pumps
See Our Catalog in Sweet's Industrial Construction and Plant Engineer's File

For more facts circle 323 on Reader Service card, p 103

Calendar

May 9-13—American Society for Metals, 2nd Southwestern Metal Exposition and Congress, State Fair Park and Sheraton Hotel, Dallas, Texas. Details: A R Putnam, ASM, Metals Park, Novelty, Ohio

May 11-14—Fluid Controls Institute, Inc, 1960 Spring Meeting, White Sulphur Springs, W. Va. Details: E R Rath, P.O. Box 667, Pompano Beach, Fla.

May 12-13—Illuminating Engineering Society, Midwestern Regional Conference, Sheraton Martin Hotel, Sioux City. Details: M Lee, Iowa Public Service Co, Orpheum Electric Bldg, Sioux City 4, Iowa

May 16-17 — Illuminating Engineering Society, Great Lakes Regional Conference, Carter Hotel, Cleveland. Details: R D Churchill, General Electric Company, Nela Park, Cleveland, Ohio

May 16-20—National Fire Protection Association, Annual Convention, Queen Elizabeth Hotel, Montreal, Quebec, Canada. Details: D Richardson, 60 Batterymarch St, Boston 10, Mass.

May 17-19 — American Society of Mechanical Engineers, Production Engineering Conference, Schroeder Hotel, Milwaukee, Wis. Details: L S Dennegar, ASME, 29 W 39th St, New York 18, N. Y.

May 18-20—Society for Experimental Stress Analysis, Spring Meeting, Hotel Severin, Indianapolis, Ind. Details: SESA, P.O. Box 168, Cambridge 39, Mass.

May 18-21—National Institute of Disaster Mobilization, Inc, 4th Annual Industrial Mutual Aid & Disaster Control Conference, Cincinnati, Ohio. Details: NIDM, 475 Fifth Ave, New York 17, N. Y.

May 22-26 — American Society of Mechanical Engineers, Oil and Gas Power Conference and Exhibit, Muehlebach Hotel, Kansas City, Mo. Details: L S Dennegar, ASME, 29 W 39th St, New York 18, N. Y.

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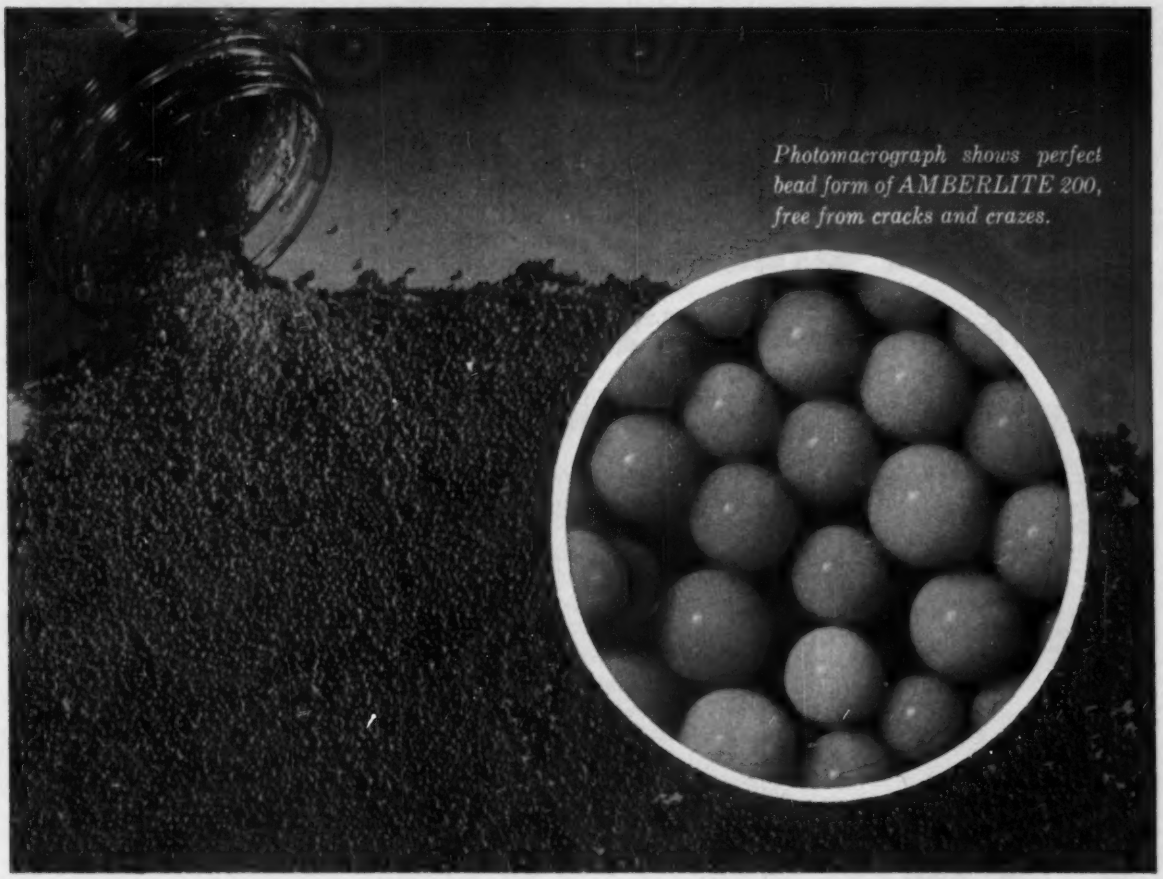

Photomacrograph shows perfect bead form of AMBERLITE 200, free from cracks and crazes.

AMBERLITE 200

Introducing new durability for Ion Exchange Resins

AMBERLITE 200 represents an entirely new concept in polymer chemistry. A high capacity, strongly acidic cation exchange resin, AMBERLITE 200 has physical and chemical stability unmatched by any available cation exchange resin.

These are some of the outstanding features of AMBERLITE 200 . . . *high resistance to oxidation*, especially in water containing chlorine, oxygen and metals such as iron, copper and manganese; *perfect bead form*, free of cracks and crazes; *high attrition resistance; stability over the entire pH range; insolubility in all common solvents.*

In water treatment in either hydrogen or sodium cycle operation, the exceptional bead characteristics of AMBERLITE 200 make possible more rapid and complete bed classification, low losses from mechanical attrition, and greater freedom from bead fracture caused by thermal and osmotic shock. For example, 2000 regeneration-exhaustion cycles using saturated brine and calcium chloride showed no measurable resin breakdown, whereas conventional cation exchange resins showed failure of from 20 to 75 percent.

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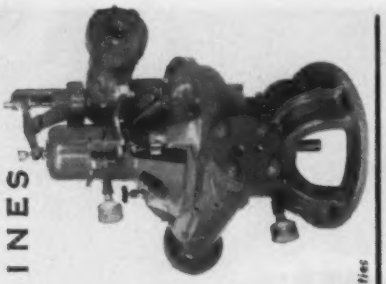
Chemicals for Industry

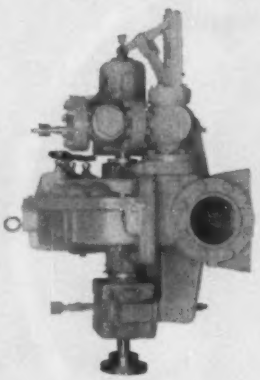
ROHM & HAAS COMPANY

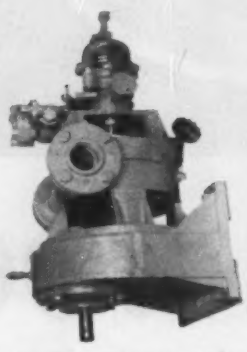
THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

For more facts circle 324 on Reader Service card, p 103







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Representatives in Principal cities

CARLING TURBINES

Calendar

Begins on page 182

May 22-26—Air Pollution Control Association, 53rd Annual National Meeting, Netherland-Hilton Hotel, Cincinnati, Ohio. Details: APCA, Annual Meeting, 2400 Beekman St, Cincinnati 14, Ohio

May 23-25—Instrument Society of America, 9th Annual Telemetering Conference, Miramar Hotel, Santa Barbara, Calif. Details: ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

May 23-26—American Society of Mechanical Engineers, Design Engineering Conference and Show, Coliseum and Statler Hilton Hotel, New York. Details: L S Dennegar, 29 W 39th St, New York 18, N. Y.

May 23-26—Rural Electric Generating Cooperatives, 11th Annual Conference, Stoddard Hotel, La Crosse, Wis. Details: N W Moser, Dairyland Power Cooperative, La Crosse, Wis.

May 25-26—American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc, Symposium on Refractory Metals and Alloys, McGregor Center, Wayne State Univ, Detroit, Mich. Details: AIME, 29 W 39th St, New York 18, N. Y.

June 1-3—Instrument Society of America, 6th Annual Instrumental Methods of Analysis Symposium, Montreal, Canada. Details: 313 Sixth Ave, Pittsburgh, Pa.

June 2-3—4th Annual Summer Conference on Vacuum Metallurgy, University Heights, New York Univ College of Engineering. Details: D R Bunshah, New York Univ College of Engineering, University Heights 53, New York City, N. Y.

June 5-9—American Society of Mechanical Engineers, Summer Annual Meeting, Statler Hilton Hotel, New York City. Details: L S Dennegar, ASME, 29 W 39th St, New York, N. Y.

June 6-9—National District Heating Association, Annual Meeting.

continued

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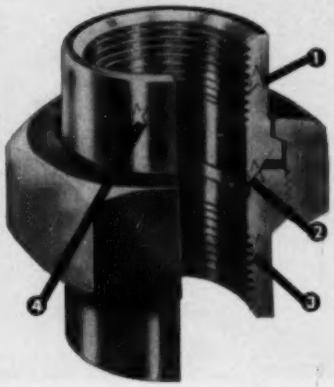
gives you all these features for your forged steel pipe union requirements



1. **Uniform walls** for even expansion and contraction under temperature changes. They follow the pipe!

2. **Catawissa Ball-to-Angle Seats** give you a "Perfect Seal" regardless of pipe alignment!

3. **More than adequate** wall thicknesses give you Catawissa's 3-to-1 Safety Factor (3000-lb. service, 9000-lb. test; 6000-lb. service, 18000-lb. test)!

4. **Round, straight barrels** for fast wrenching. No uneven or tapered surfaces to cause wrench slips or wrench locking!

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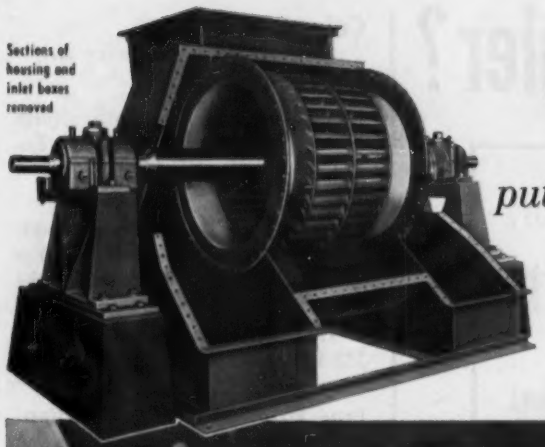
circle 325 on Reader Service card, p 103

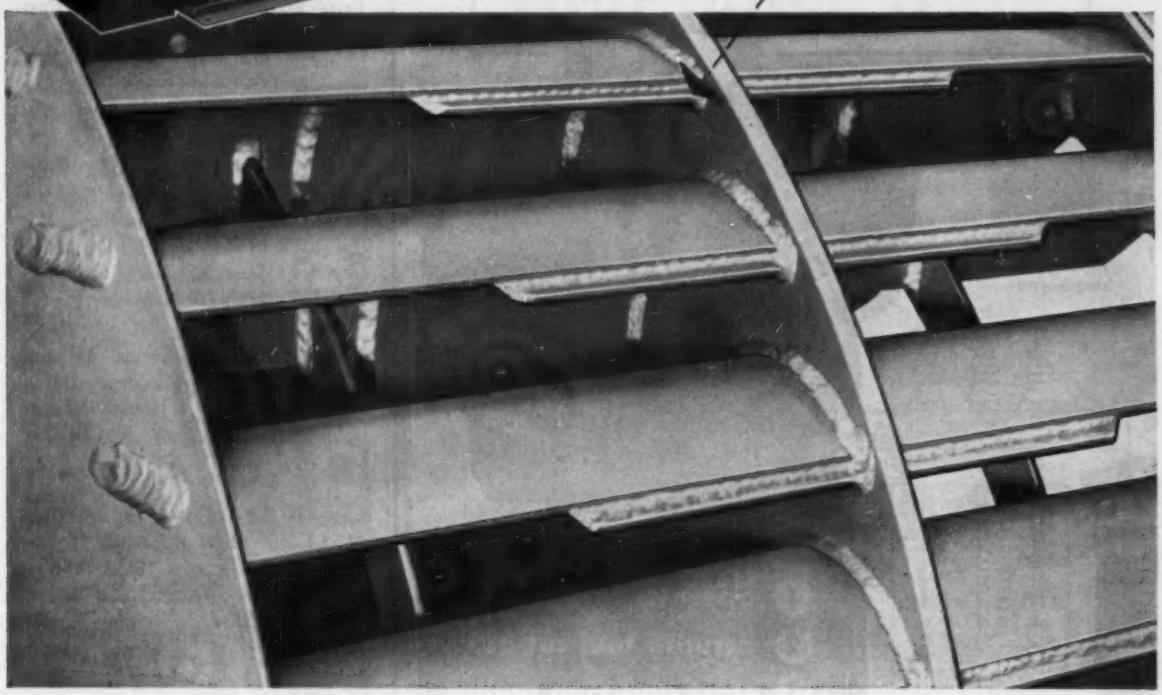
circle 326 on Reader Service card, p 103



CLARAGE

puts wearing plates where they belong

on the face of the blades



DON'T SETTLE FOR LESS! Clarage makes sure you get *extra* service life on those punishing induced draft applications.

The Type DN Dynacurve fan, when equipped with wearing plates, has these abrasion-resisting steel plates welded to the *face* of the wheel blades. A distinguishing Clarage feature that guarantees you less maintenance, longer operation! But that's not all.

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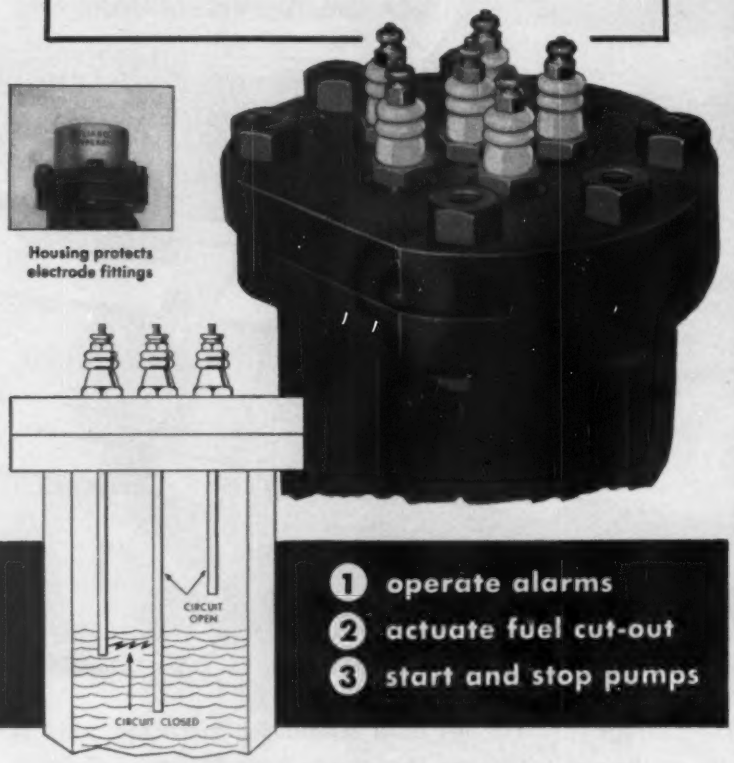
For more facts circle 327 on Reader Service card, p 103

What could be simpler?

Your boiler water is a conductor;

Its rise and fall can be made to make and break circuits;

Simple efficient control to 1, 2, 3 (below)



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Electrode Levalarms are entirely electrical; they do not depend on vacuum tubes or magnets — have no stuffing boxes or bellows. Models available for every pressure or temperature.

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The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance BOILER SAFETY DEVICES

Calendar

Begins on page 182

Grove Park Inn, Asheville, North Carolina. Details: NDHA, 827 Euclid Ave, Pittsburgh 6, Pa.

June 8-9 — Illuminating Engineering Society, Northeastern Regional Conference, Westworth-by-the Sea, Portsmouth, N. H. Details: C M Holden, Champion Lamp Works, 330 Lynnway, Lynn, Mass.

June 10-26—British Exhibition, sponsored by Federation of British Industries, Coliseum, New York. Details: A A Schechter, 551 Fifth Ave, New York 17, N. Y.

June 13-14—Illuminating Engineering Society, Canadian Regional Conference, Nova Scotian Hotel, Halifax, N. S. Details: H Lushington, Canadian General Electric Company, Ltd, Halifax, N. S., Canada

June 13-15—American Association of Cost Engineers, Annual Meeting, Rice Hotel, Houston, Texas. Details: E D Shanken, AACE, Durham, N. H.

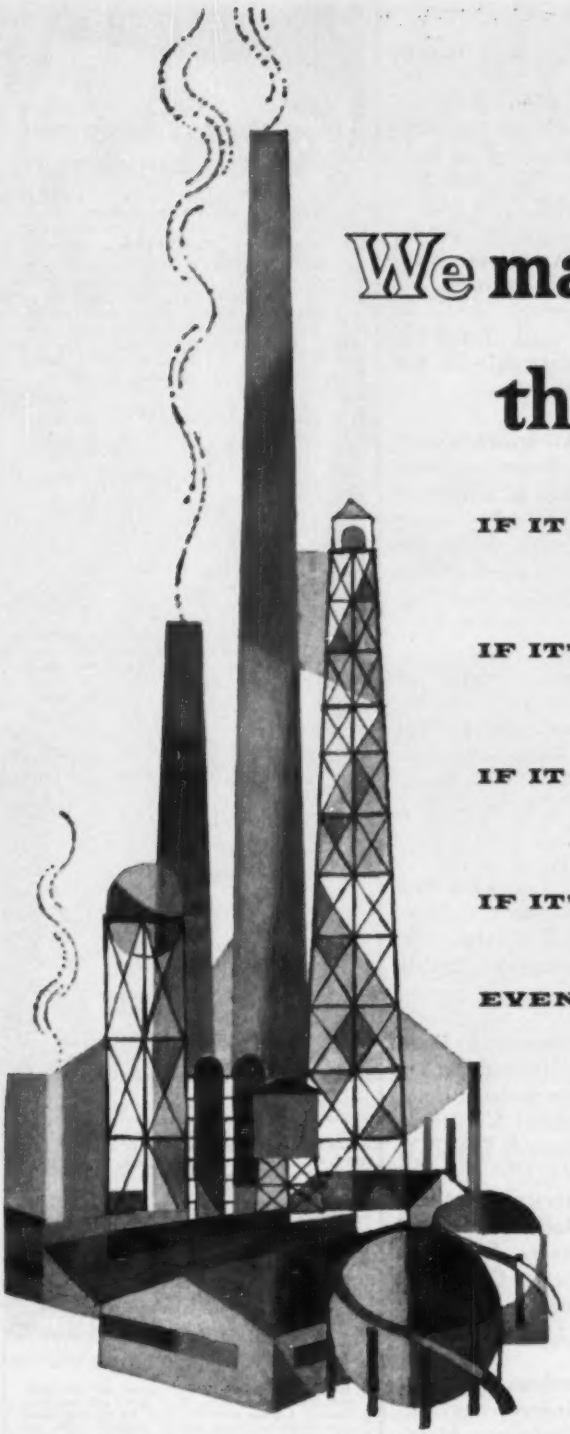
June 19-22—American Institute of Chemical Engineers, Spring Meeting, Del Prado Hotel, Mexico City. Details: AICHE, 25 W 45th St, New York 36, N. Y.

June 20-22—American Society of Mechanical Engineers, Applied Mechanics Conference, Pennsylvania State Univ, University Park, Pa. Details: L S Dennegar, ASME, 29 W 39th St, New York 18, N. Y.

June 20-24 — American Society for Engineering Education, 68th Annual Meeting, Purdue University, Lafayette, Ind. Details: Purdue University, Lafayette, Ind.

June 25-July 5—Instrument Society of America, 1st International Congress for Automatic Control, AACC sponsored with ASME, IRE and AICHE cooperating, Moscow, U.S.S.R. Details: ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

July 11-12—Conference of Response of Materials to High-



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The Fairbanks, Morse line of pumps includes a type, size and capacity for almost any pumping requirement—and the power unit matched to drive it!

Pump sizes to 152 inches... capacities to 800,000 gpm... heads to 3000 psi.

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Fairbanks, Morse

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This valuable, free bulletin may be obtained by writing D. W. Haering & Company, Inc., P.O. Box 10337, San Antonio 21, Texas.

circle 330 on Reader Service card, p 103

Calendar

Begins on page 182

Velocity Deformation, sponsored by Physical Metallurgical Comm., Inst of Metals Div, TMS, Estes Park, Colorado. Details: AIME, 29 W 39th St, New York 18, N. Y.

August 9-12 — American Institute of Electrical Engineers, Pacific General Meeting, El Cortez Hotel, San Diego, Calif. Details: H R Hughes, 1109 Alexandria Dr, San Diego 7, Calif.

August 15-17—American Society of Mechanical Engineers and American Institute of Chemical Engineers, Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N. Y. Details: L S Dennegar, 29 W 39th St, New York City.

Sept 7-9—American Society of Mechanical Engineers, Automatic Control Conference and Exhibit, Mass Institute of Technology, Cambridge, Mass. Details: L S Dennegar, ASME, 29 W 39th St, N. Y.

Sept 7-15—2nd Coliseum Machinery Show, Coliseum, Chicago, Illinois. Details: A B Perkins, 2807 Sunset Blvd, Los Angeles 26, California.

Sept 11-16—Illuminating Engineering Society, National Technical Conference, Penn Sheraton Hotel, Pittsburgh, Pa. Details: A D Hinckley, IES, 1860 Broadway, N.Y. 23, N.Y.

Sept 15-16—American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc, Engineering Management Conference, Morrison Hotel, Chicago, Ill. Details: AIME, 29 W 39th St, N.Y. 18, N.Y.

Sept 15-16—American Society of Mechanical Engineers, Engineering Management Conference, Morrison Hotel, Chicago, Ill. Details: ASME, 29 W 39th St, New York 18, N. Y.

Sept 21-23—Power Conference, sponsored by ASME, AIEE, Bellevue-Stratford Hotel, Philadelphia, Pa. Details: ASME, 29 W 39 St, New York 18, N. Y.

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The "slave-hands" of an AI technician handle radioactive materials through a hot cell window 3½ feet thick. Woodcut by Edward Kysar.

Let A.I.'s experience guide your Nuclear Power Program

The largest privately-owned facility in the world for remote handling of radioactive materials is located at Atomics International's 290-acre field laboratory near Los Angeles. Here the men who pioneered the creative peacetime uses of atomic energy are applying their 14 years of experience to developing advanced nuclear reactors and associated equipment.

Much of AI's work has been on projects for the U.S. Atomic Energy Commission. This includes the Organic Moderated Reactor Experiment at the National Reactor Testing Station in Idaho and the Sodium Reactor Experiment in California. AI has also built and is operating SNAP II, a 220-pound prototype reactor designed to produce 3 KW of electricity for space vehicles.

With some of the most sophisticated facilities in the world at their disposal, the men at AI are now conducting studies for large power station reactors in the United States and Europe. Two reactors are now actually under construction under AEC programs—an Organic Moderated Reactor in Piqua, Ohio, and a Sodium Graphite Reactor in Hallam, Nebraska. Smaller research reactors have been built by Atomics International for Denmark, Germany, Italy, Japan, Puerto Rico and several sites in the U.S.A.

For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

Other offices in: Washington, D.C., U.S.A.; Geneva, Switzerland. Affiliated with: INTERATOM, Bensberg/Cologne, Federal Republic of Germany and DYNATOM, Paris, France.

New ILLINOIS STOKERS feature "LIVE-ACTION" GRATE SURFACE

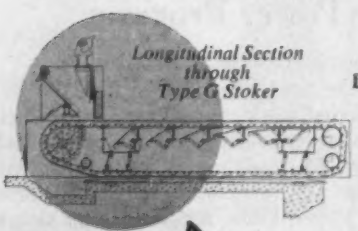
TYPE G HIGH FRAME
CHAIN GRATE STOKER

PROMOTE MORE EFFICIENT COMBUSTION AT LOWER AIR PRESSURES

Patented bevel-top links convert about 90% of the dead surface of ordinary square links into live-action area. Air flowing under almost all of the fuel bed fans combustion to an exceptionally high level. Resultant use of low windbox pressures reduces fly ash . . . reduces power requirements . . . and reduces fuel costs as finer coal can be used.

- *Bevel-Top Links for Bituminous Only*
- *Special Overlapping Links for Anthracite*
- *Self Cleaning Links*
- *Choice of Cast Iron or Cast Steel Links*
- *Continuous Automatic Discharge of Ashes*
- *Zone Control of Air Pressure*
- *Any Size — Any Type Custom Engineered to Your Requirements*

YOU SPECIFY — WE SATISFY



Longitudinal Section through Type G Stoker

16 IMPROVEMENTS ENGINEERED INTO THE 1960 ILLINOIS STOKER

Development ranging from improved construction features to redesigned components facilitate operation and maintenance. The finished product reflects the skill of more than 50 years of design and engineering experience. Write for full details.

Illinois Stoker Alton, Illinois DEPT. P-560

Manufacturers of: INDUSTRIAL STOKERS • INCINERATOR STOKERS • SINTERING MACHINES

SEND TODAY FOR NEW BROCHURES

Gentlemen: We're interested; please send complete details:

FIRM NAME _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

SIGNATURE _____

Appointments

Management changes

L L Warriner

Cooper-Bessemer Corporation's new board chairman is L L Warriner, company director for the past 15 years. Management-and-engineering consultant Warriner has held executive posts with Fairbanks-Morse Company, A O Smith Corp, Summitville Mines and The Master Electric Company. He retired as Master Electric's president in 1956.

He fills a post recently vacated by L F Williams, who will continue with Cooper-Bessemer as a director and member of the executive committee.

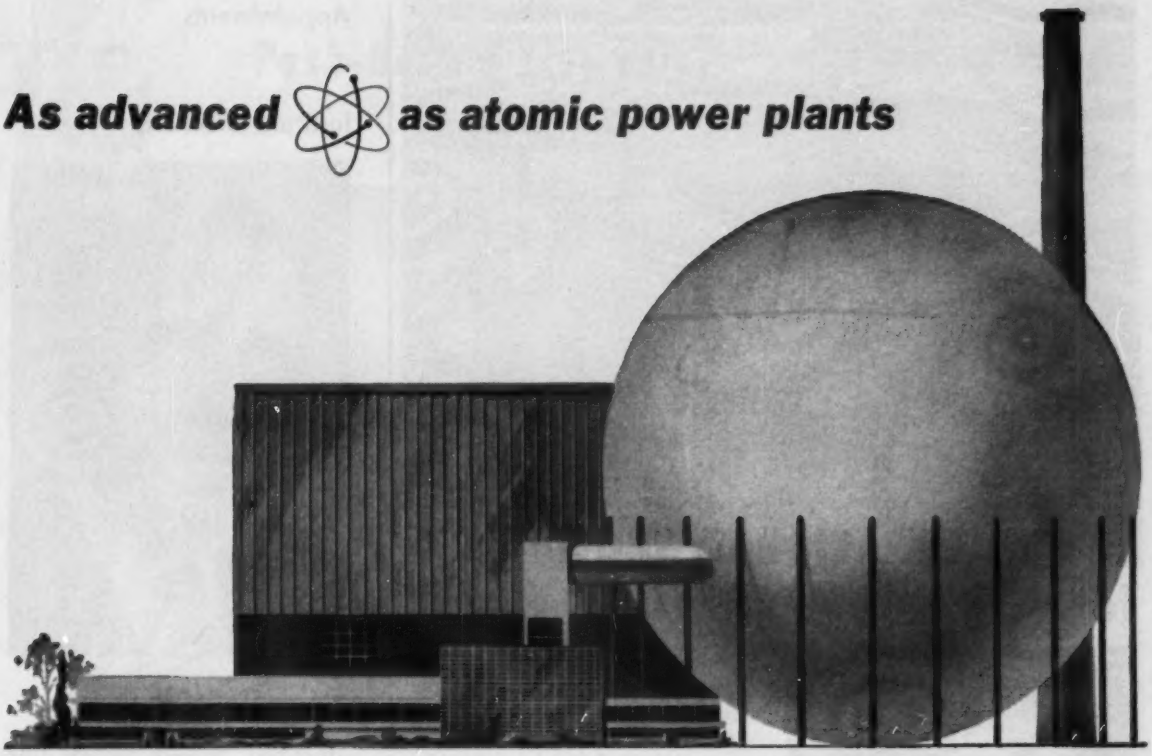
Henry Morgan

Electronic Controls Inc has elected Henry Morgan president and general manager. A graduate electrical engineer, Morgan developed a long-range program of planned corporate growth in the electronic-control field which resulted in the formation of this company, to design, manufacture and market automation equipment and control systems for military and industrial applications.

Prior to this election, Morgan was with Burndy Corp where he served in management capacities for eight years. At Gorn Electric Company he was management consultant and general sales manager. He is a member of the American Society for Quality Control, American Rocket Society and AIEE.

continued

As advanced as atomic power plants



INFILCO ION EXCHANGERS

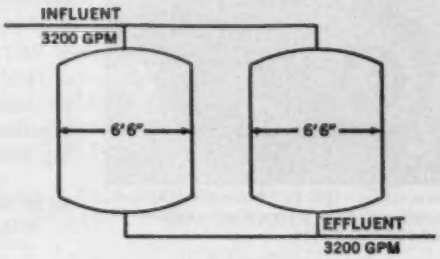
treat boiling water reactor condensate at

50 GPM PER SQUARE FOOT

Two 6'-6" diameter mixed bed demineralizers with a total surface area of 64 sq. ft. are now being installed to handle 3,200 gpm of reactor condensate. These units will produce polished condensate with a conductivity of approximately 0.1 micromho in a fraction of the space and at much lower installation cost than conventional equipment.

The plant design is based upon extensive pilot plant studies using a 24" diameter unit to treat unfiltered condensate at 200 gpm (68 gpm per sq. ft.). The equipment and techniques developed for this plant are also applicable to high pressure conventional and super-critical pressure plants.

Results of pilot plant studies and design features of this ultra-modern installation will be sent free upon request. Write today for Reprint #88.



Infilco Inc., General Offices: Tucson, Arizona, P.O. Box 5033
Field Offices throughout the United States and in foreign countries.

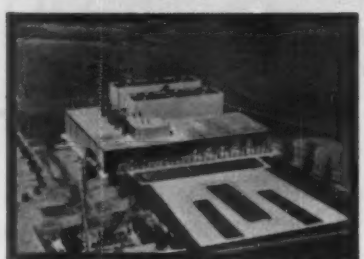
INFILCO

"Eminence in equipment design for water, sewage, and waste treatment . . . since 1894."

58501

655-acre "Terminal City"—New York International Airport

THE INTERNATIONAL SHOW PLACE for HIGH TEMPERATURE WATER



Central Heating and Refrigeration Plant keynotes the versatility of HTW

These four LFW-20 International-LaMont Generators have a combined capacity of 160,000,000 Btu/hr.

The unmatched economies of high temperature water are realized throughout the year at New York International Airport. In addition to heating the vast Terminal City, HTW (380° F. at outlet) produced by four International-LaMont Generators feeds nine absorption machines in the unique Central Heating and Refrigeration Plant—the first of its type. Visit it next time you stop at Idlewild.

International Airport is only one of the major HTW installations both here and abroad. To date, more than 130 International-LaMont High Temperature Water Generators are in operation with a total capacity exceeding THREE BILLION Btu/hr. All of these employ the proven LaMont principles of forced recirculation which permit temperature differential to 200° F. or more with no danger of thermal shock—the key to truly significant economies.

Take a closer look at HTW in terms of International-LaMont — the most experienced name in this rapidly growing field.

Get full details from your INTERNATIONAL DISTRICT REPRESENTATIVE or write for Bulletin 1600 today.

IBW BOILER BUILDERS SINCE 1886

THE INTERNATIONAL BOILER WORKS CO.

930 Spruce St. East Stroudsburg, Pa.

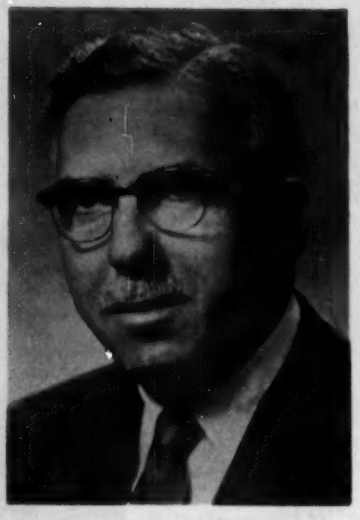
Steel Firebox Heating & Power Boilers Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products

Manufactured and sold in Canada under agreement with CANADIAN VICKERS LTD. Montreal, P. Q.

Appointments

Begins on page 190

Institute elections



Daniel D Wile

American Society of Heating, Refrigerating and Air-conditioning Engineers' new president is Daniel D Wile, vice-president and chief engineer of Recold Corporation, Los Angeles. He has been associated with the society since 1934.

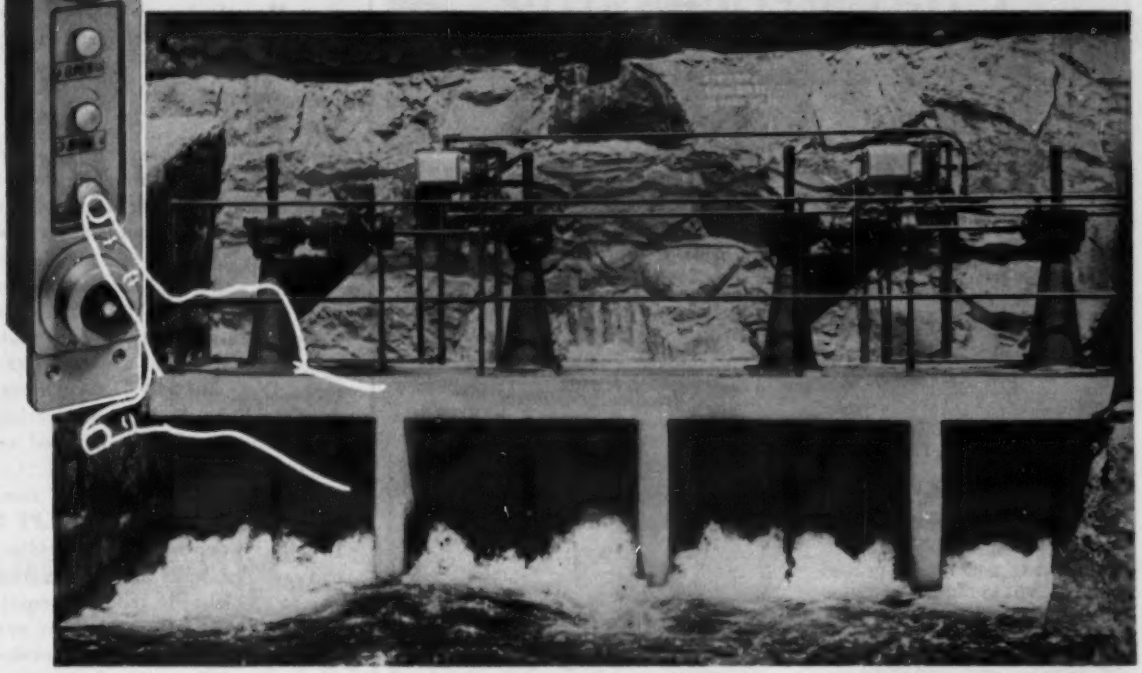
Well-known for many technical articles and speeches covering a wide range of subjects in the refrigeration, air-conditioning and automatic-control fields, he twice received the society's Wolverine Award for outstanding publications. One of his recent speaking engagements was at the 10th International Congress of Refrigeration in Copenhagen, Denmark.

Wile joined Recold Corporation in 1947. He has won many patents on control devices and other refrigeration and air-conditioning equipment. He is a graduate of the University of Kentucky College of Engineering.

The Aluminum Association: M M Anderson, president; S D Den Uyl, chairman of board. **National Association of Corrosion Engineers:** G E Best, president; E C Greco, vice-president elect; C G Gribble, treasurer.

National Association of Power Engineers: O Ward, president; G W Asher, vice-president. **National Electrical Manufacturers Asso-**

Push-Button operation of SLUICE GATES



LimiTorque OPERATORS are widely used

Shown above are four 54" x 54" Sluice Gates operated by *two* LimiTorque Valve Operators at the Plant of the Connecticut Power Company . . . This unusual design and installation was the result of the cooperation of Rodney Hunt Machine Company and LimiTorque Engineers and proved to be economical and very satisfactory in service. Our sales and engineering staff is ready to aid you at any time with your valve operator problems.

LimiTorque automatically opens and closes valves and sluice gates from a conveniently located control point—eliminating guesswork and reducing labor costs. One man can operate any type of valve quickly and dependably in remote, inaccessible or hazardous locations; thus vital operating procedure can be handled easily by key personnel, safely and economically, and at the correct speed . . . And these controls may be mounted on any size valve, in almost any position or location.

LimiTorque controls can be field-mounted on existing valves—contact your valve manufacturer, or your nearest LimiTorque Sales-Engineering Office.

Write for complete Catalog L-550—and please use your Business Letterhead when requesting it.

THERE IS NO SUBSTITUTE FOR —

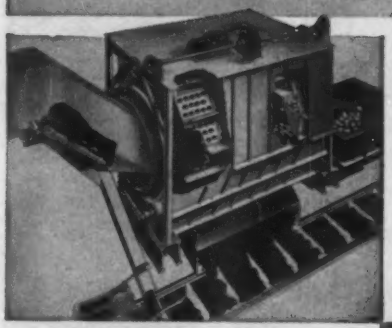
LimiTorque®

PHILADELPHIA GEAR CORPORATION
KING OF PRUSSIA (SUBURBAN PHILADELPHIA), PA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS
Limitorque Corporation • King of Prussia, Penna.

More and more utilities now use this

Rugged Cost Cutting Coal Processing Equipment

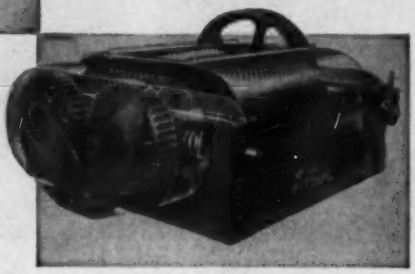


McNally Pittsburg Rotary Breaker

This heavy-duty unit allows positive control of top size in handling run-of-mine washery feed. Production of fines is held to a minimum. Without center shaft or spoke interference, costly maintenance is usually drastically reduced.

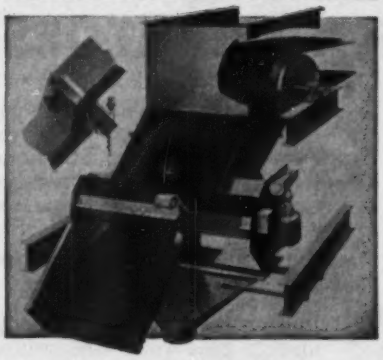
Gearmatic Stoker Coal Crusher

Built to handle heavy coal tonnages, these crushers have proved most efficient to reduce 8" minus to stoker grades. They offer three major advantages: 1) high volume production; 2) accurate sizing; 3) low percentage of fines.



McNally Pittsburg Primary Coal Sampler

This automatic sampler (adjustable from 1 to 30 minutes) cuts out true samples of the coal stream. Cutter opening permits largest particle of stream to pass freely into cutter. Conveyor discharges into chute in which sampler is installed.



Ask the men who know coal from the ground up!

Your McNally Pittsburg man offers more than 37 years of experience in the preparation of coal. He can save *you* time and money in the selection of equipment to do your job more efficiently. *Write today!*

McNALLY PITTSBURG

MANUFACTURERS OF EQUIPMENT TO MAKE COAL A BETTER FUEL

McNally Pittsburg Mfg. Corp.
Dept. P, Pittsburg, Kansas
Gentlemen: Send me more information on these products:
☐ Rotary Breaker ☐ Coal Crusher ☐ Primary Coal Sampler

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Appointments

Begins on page 180

ciation, Dry Battery Section: E D McEachron, chairman; R L Glover, vice-chairman. **National Insulation Manufacturers Association:** H T Williams, vice-president.

New names

Associated Laboratories: a national association formed for treatment of water-conditioning problems in all areas. **Bivans Conveyor Company:** new firm will design, fabricate and install industrial conveyors. **Harbison - Carborundum Corporation:** jointly owned subsidiary by Harbison-Walker Refractories Company and The Carborundum Company for the engineering, manufacture and sale of fused refractories.

Hysol Corporation: new name for Houghton Laboratories. **LPI L Leasing Corporation:** subsidiary of Lease Plan International Corporation to specialize in industrial equipment financing. **Rexarc, Inc:** new name for The Sight Feed Generator Company. **Ultrasonic Industries, Inc:** new firm will manufacture and sell ultrasonic cleaners.

Industrial Gas Cleaning Institute, Inc: new trade organization formed by manufacturers of gas cleaning equipment. **Commercial Chemical Products, Inc:** water treatment specialists formerly Commercial Products Co. **Consolidated Vacuum Corporation:** formerly Rochester Div of Consolidated Electrodynamics Corp.

Materials and Methods, Inc: chemical consulting service and laboratory. **Industrial Systems Div:** new name for Minneapolis-Honeywell Regulator Company's facility at Beltsville, Md. **U S I-International:** National Distillers and Chemical Corporation subsidiary in Switzerland to expand sales of U.S. manufactured polyethylene. **Swartwout Fabricators, Inc:** former Ventilator Div of The Swartwout Company, recently purchased by former Swartwout vice-president, G V Patterson. **United Electric Controls Ltd:** manufacturing facility in Canada for United Electric Controls Company.

continued

the remarkable new pipe insulation that's really TOUGH!

ZEBRA

You don't have to handle Zebra with kid gloves. This multi-layer sectional-type thermal insulation has real body . . . doesn't break easily. In fact, its deflection at breaking point is 2 to 4 times that of ordinary insulation.

A low, medium, and high-*temperature* pipe insulation, Zebra is made in half sections in all pipe sizes to facilitate handling and reduce the number of joints. This, plus its light weight, speeds application and keeps installation cost *low*. Zebra is easy to cut and fabricate. And it's reusable . . . can be dismantled and re-applied.

What's more, Zebra won't cause skin irritation or cuts. It has a smooth surface . . . no ragged ends. And it's practically dust free.

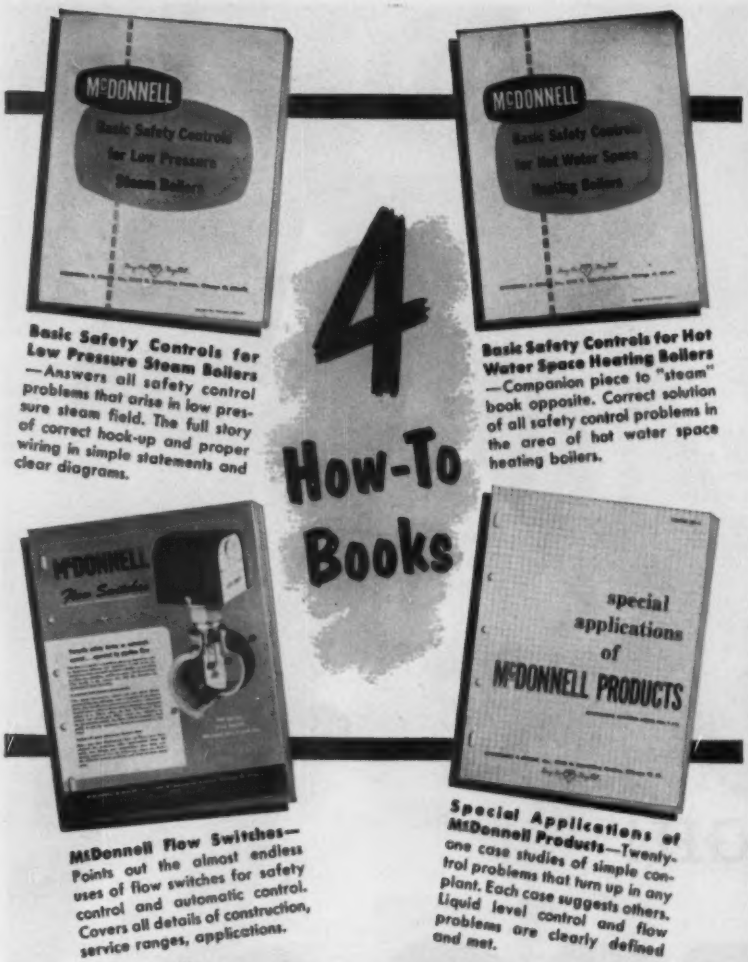
• for temperatures of 200° F to 1200° F • made of calcium silicate-asbestos fibre bonded felts • withstands shock and heat without warping or abrading • meets requirements for density, conductivity, modulus of rupture • available in wide range of sizes and thicknesses • tested by an independent testing laboratory

Write today for more information on "K&M" Zebra—the remarkable new pipe insulation that's really tough! Keasbey & Mattison Company, Ambler, Pa., Dept. I-150.

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON at Ambler

For more facts circle 339 on Reader Service card, p 103



Basic Safety Controls for Low Pressure Steam Boilers—Answers all safety control problems that arise in low pressure steam field. The full story of correct hook-up and proper wiring in simple statements and clear diagrams.

Basic Safety Controls for Hot Water Space Heating Boilers—Companion piece to "steam" book opposite. Correct solution of all safety control problems in the area of hot water space heating boilers.

McDonnell Flow Switches—Points out the almost endless uses of flow switches for safety control and automatic control. Covers all details of construction, service ranges, applications.

Special Applications of McDonnell Products—Twenty-one case studies of simple control problems that turn up in any plant. Each case suggests others. Liquid level control and flow problems are clearly defined and met.

—for every engineer

Here are four bulletins that can make a basic contribution to the things every operating man seeks...more efficient operation... automatic operation...safer operation.

Read the brief descriptions of these booklets. ***Use the coupon to request any or all of them.***

McDONNELL & MILLER, Inc.
3506 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

COUPON BRINGS THEM—

Send me a copy of bulletin(s) checked:

- ☐ Steam Booklet, L-711
- ☐ Hot Water Companion Booklet, P-30-C
- ☐ Flow Switch Bulletin, FS1
- ☐ Special Application Booklet, ERS-A

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Address_____

City, Zone, State_____

By_____

Mail to: McDonnell & Miller, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

Appointments

Begins on page 180

Retirements

Francis N Luce, Norton Company assistant superintendent of Plant 2, after 39 years.

Irving W Stanton, exhibition engineer for Norton Company, after 33 years.

Obituaries

George S Hewins

New England Power System's former construction manager, George S Hewins, died on Feb 20 after a long illness. He was 85. Hewins, who directed construction of many of New England's largest dams and power plants, also supervised first harnessing of the Connecticut River for electrical purposes.

A native of Dedham, Mass, he graduated from the Massachusetts Institute of Technology. In 1908 he was superintendent of construction of the Vernon hydroelectric plant near Brattleboro, Vt. He later directed building of the Harriman power station in Whitingham, Vt. as construction manager. Many stations which send power to Central Massachusetts, Vermont and New Hampshire have been constructed under Hewins' supervision.

He was associated with New England Power System for 38 years and served as its construction manager for 20 years.

Charles C Egbert, pioneer in designing hydroelectric-power-generating facilities, on February 29 at the age of 85.

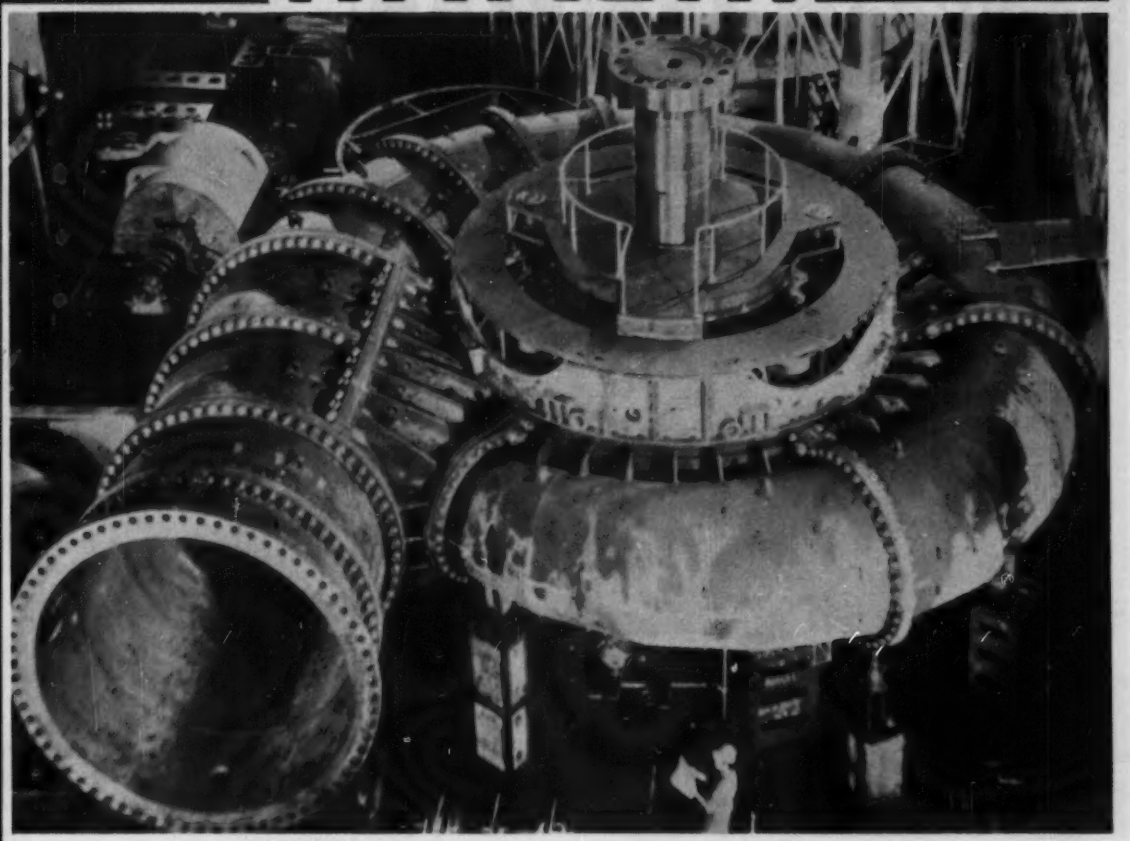
Hugh J Hush, president of Griffin Wellpoint Corporations and Griffin Equipment Corporation, on March 2 at the age of 54.

Albert Babcock McCoard, vice-president and principal financial officer of New Orleans Public Service, on March 25. He was 70 years old.

George Robert Strandberg, former consulting engineer for Stone & Webster Engineering Corporation, on March 16. He was 71.

Richard M Wood, construction manager with Stone & Webster Engineering Corporation, on March 21 at the age of 60.

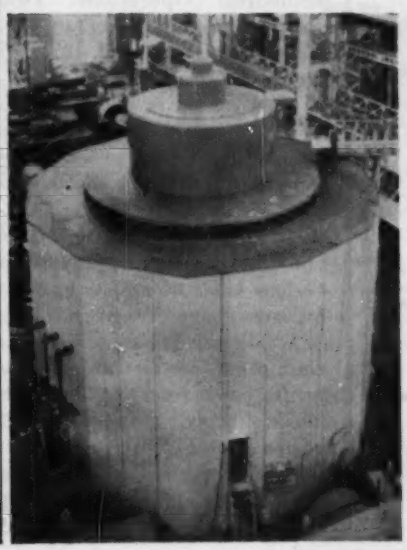
HITACHI



Another big Hydraulic Turbine and Generator by Hitachi

Hitachi has recently completed two 137,500kw/125,000kVA hydraulic turbines and generators for the Miboro Power Station in Central Japan.

The turbine is of the vertical-shaft Francis type, and specified for a speed of 225rpm, a maximum effective head of 200m and 76.6 cu.m/sec water flow, making it one of the largest units of its kind in the world. Its runner has a maximum diameter of 3.7m and the main shaft a diameter of 95cm. The spiral casing, which was constructed in 13 sections to facilitate transportation to the site, has an inlet diameter of 3.35m and an outer diameter of 11.2m.



The generator presents a high-torsoed appearance as shown in the photograph, having been so designed in consideration of the comparatively high speed. Since the generator was designed for a rated voltage of 16,500 volts and, in this respect, represents the first such attempt in Japan, particular care was taken in the corona-shielding and impulse resistance of the stator winding.

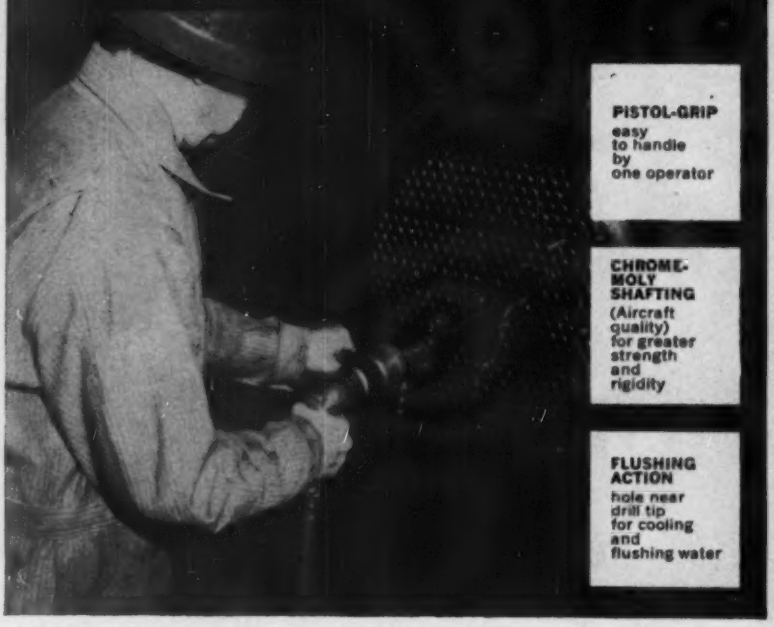
The generator is rated at 60 cycles, 225rpm and 0.9 power factor but is also capable of operating at 50 cycles, 187.5rpm and 1.0 power factor.

Hitachi, Ltd.
Tokyo Japan
Cable Address: "HITACHY" TOKYO

For more facts circle 341 on Reader Service card, p 103

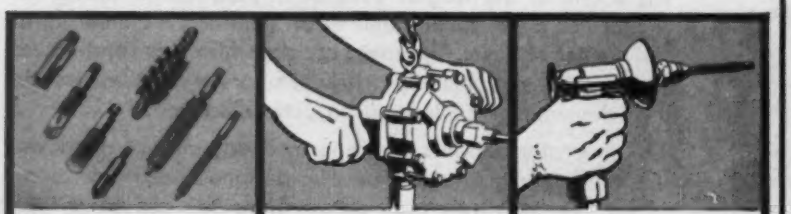
newest ELLIOTT tube cleaner

lightweight! air-driven!


PISTOL-GRIP
easy to handle by one operator
CHROME-MOLY SHAFTING
(Aircraft quality) for greater strength and rigidity
FLUSHING ACTION
hole near drill tip for cooling and flushing water

for condenser and heat exchanger tubes

Lightweight. Powerful. Air-driven. Trigger-action control with speed governor to prevent shaft-whip. High-speed motor reduced through planetary gears to 1500 rpm. Integral water-feeding attachment with finger-action valve which controls flow of cooling water into hollow shaft and drill or brush. Built-in oil reservoir. Send for tube cleaner bulletin Y-48.



DRILLS AND BRUSHES FOR VARIED NEEDS
Brushes for light deposits. Four types of drills clean light, hard-heavy, hard-light, and gummy deposits.

SUSPENSION TYPE
Air, steam or electric heavy-duty motor, for removing hard, heavy deposits. Ball bearings absorb thrust in either direction.

ELLIOTT JIFFY GUN
For extra-fast cleaning of light deposits in tubes ½ in. to 1¼ in. Air or water pressure shoots nylon brushes or rubber plugs through tubes.

ELLIOTT Company
Lagonda Plant—Springfield, Ohio

Y8-4

Bookshelf

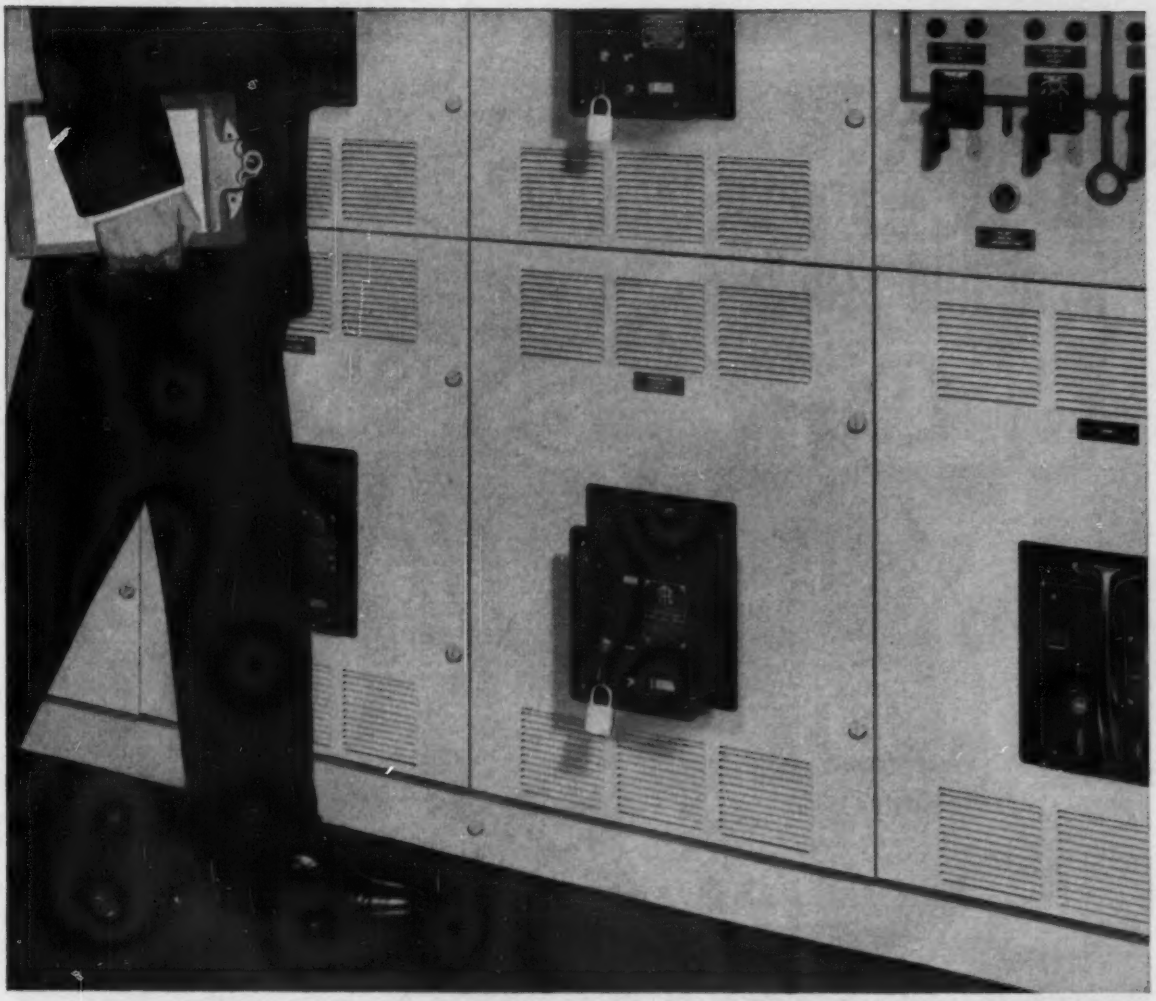
Electrical Engineering for Professional Engineers' Examinations. *By J D Constance. 272 pp, 41 illust, $9.50. McGraw-Hill Book Co, 330 W 42 St, New York 36, N. Y.*
This book helps prepare the license candidate to pass the electrical-engineering examination for professional engineers in various states. Problems with solutions, mainly from past examinations from different states, are explained and illustrated. Problems on each topic are preceded by a review of theory involved. The book includes a broad list of reference books, and has a question index as well as a subject index. It should prove a good basis for familiarizing yourself with type and scope of examination problems.

Subjects covered in 19 chapters include: electrical units and Ohm's law, battery circuits, units of area and resistance, temperature coefficients, power energy, wire sizing, dc measurements, transmission and machinery; ac theory, machinery, transmission, power circuits and transformers; lighting and electronic tubes and circuits. Unfortunately, treatment of the various topics is somewhat uneven. Some topics get excellent treatment; handling of others leaves something to be desired.

Accident-Prevention Manual for Industrial Operations, Fourth Edition. *1542 pp, 500 illust, $15.50. National Safety Council, 425 N Michigan Ave, Chicago 11, Ill.*
Revised edition is summation of 46 years of safety experience, draws on knowledge of safety men from 7000 industrial firms. New chapters cover handling radioactive materials, nondestructive means of testing materials and products through radiography, various kinds of radiation and safe exposure limits.

Accident investigation, analysis and cost; plant construction and maintenance; power trucks and tools; flammable liquids; personal protective equipment; medical, nursing and first-aid service in industry; table of chemical hazards are other topics covered in this informative reference.

For more facts circle 342 on Reader Service card, p 103



Several of these circuit breakers are in the disconnected position. Yet the doors are safely closed. Wouldn't you like this feature in the switchgear you are going to live with for 20 years?

Why stumble over a circuit breaker door for 20 years?

Don't let yourself be pushed around by a 600 volt switchboard. Fight back. Insist on equipment that lets you rack the breaker out to test or disconnect position without ever opening the door . . . completely safe equipment with no live parts exposed and no open doors to admit dust (see maker's name below).

Only one make of 600 volt switchgear offers this advantage (see name below). In 1957, when this line was introduced, it was the first to give you the miracle of manual stored energy closing. Today, naturally, you expect stored energy in any make of switchgear you buy.

But only this one company (see below) offers the additional advantages of completely closed door disconnect, plus expanded range trip devices that let your breakers grow with your loads. Each trip device has three to four times the range of conventional devices. Saves both cost and downtime.

The surprise is that you pay no more for this—today's most advanced 600 volt gear. Why settle for anything else? For complete descriptive Bulletin 6004-C, write I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

For more facts circle 343 on Reader Service card, p 103

NOW... prompt delivery from mill stocks!

Stainless
Condenser and Heat Exchanger Tubes

Save time in getting Types 304 and 316 stainless condenser and heat exchanger tubes for new units or re-tubing jobs. Call your nearest Carpenter office for prompt delivery from large mill stocks of sizes ⅜" to 1" O.D. in 18 and 16 BWG. Stock lengths up to 40 feet are cut to your specific requirements. These full-finished tubes fully meet ASTM Spec. A-249. Besides, they pass the most searching nondestructive test applied to stainless tubing anywhere. This extra-close quality control is your assurance of getting the highest possible degree of perfection and dependability in Carpenter Stainless Tubes. That means savings in time, money and trouble for builders and users of heat transfer equipment.

If you need other standard or special-purpose types of heat exchanger tubes, Carpenter can supply them also. Our technical staff is always available for competent assistance on any stainless tubing or pipe problem. For prompt service on your next orders, contact your Carpenter representative or the mill. The Carpenter Steel Company, Alloy Tube Division, Springfield Road, Union, N.J.

your master key to cost-saving corrosion control

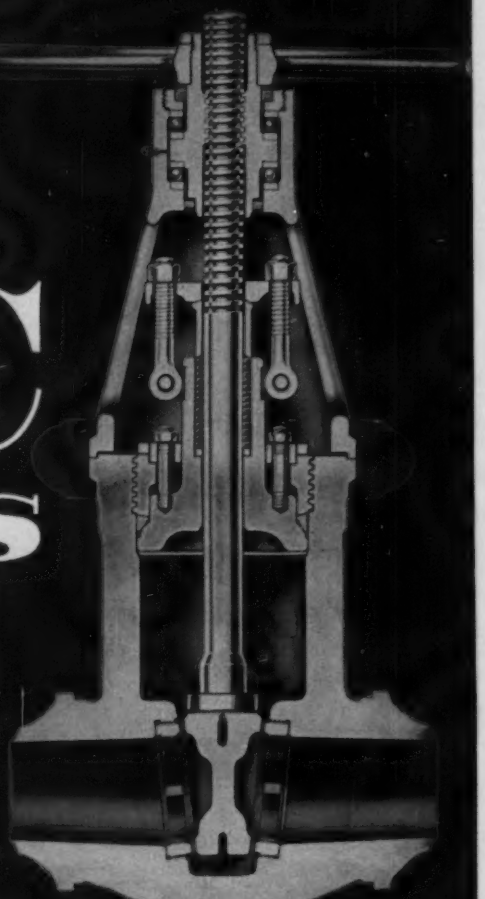
The Carpenter Steel Company • Alloy Tube Division • Union, N.J.

Stainless Tubing & Pipe

ACCO
for Better
Values

R-P&C VALVES

THE COMPLETE LINE
—DESIGNED FOR DEPENDABILITY



R-P&C Pressure Sealed Valves Meet Requirements of High Pressure and High Temperature Applications

• The R-P&C Pressure Sealed Valve pictured above—made of electric furnace cast steel—has been successfully developed to meet demands for valves that provide tightness under varying conditions encountered at high pressures and high temperatures. These valves, available in gates (up to 12″) and globes (up to 8″) in 900, 1500 and 2500 pound classes, are also being used increasingly for less difficult services, because of the *inherent advantages of pressure-sealed construction.*

Among these advantages are: elimination of bonnet flanges; tightness unaffected by temperture changes; quick, easy inspection—disassembly and reassembly; reduced weight without loss of strength; savings of space; ease of insulation; neat appearance.

R-P&C Pressure Sealed Valves typify the high quality of the entire cast steel line, including gate, angle, globe, swing check and lift check styles in many sizes and pressure classes (150-2500 psi).

A COMPLETE Line of Valves

Whenever you need valves of *any* kind, it's good business to look to R-P&C. The R-P&C Valve line includes gate, globe, angle and check valves in bronze, electric iron and cast steel, and forged steel. Also, R-P&C offers a full line of cast steel fittings, as well as specialties such as bar stock and Lubrotite gate valves, asbestos-packed cocks and other items.

• • •

Write our Reading office for catalog.

FREE WALL CHART
"How to Protect Your Valves"
Installation pointers, operating tips, clues to longer valve life. They are all on this 22″ x 17″ wall chart. Write for your free copy.

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

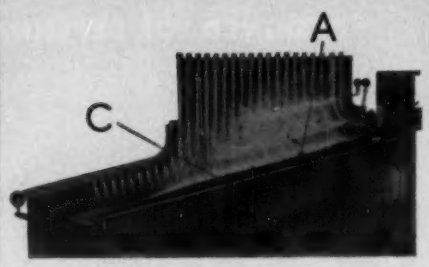
Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

ACCO

The only preventive maintenance required on a Vibra-Grate Stoker is for a mechanic to grease it every three months at four points on the front.

AT SPAULDING FIBRE COMPANY
(makers of ARMITE, SPAULDITE fibres and plastics)

Vibra-Grate Stokers save 1000 tons of coal per year!



With AE Vibra-Grate Stoker, intermittent agitating action feeds coal down inclined grates (A) at controlled rate. This automatically levels fuel, eliminates spotty burning. Separate zones (B) permit exact adjustment of forced draft air for proper combustion at all stages of burning. Water-cooled grates (C) virtually eliminate maintenance. Stoker feeds wet or dry coal of any grade. Water-cooled grates permit burning gas or oil without damage to grates. Quick conversion from or to coal now possible.

The two 50,000-lb AE Vibra-Grate Stokers shown above went on line at the Tonawanda plant of the Spaulding Fibre Company in 1958.

Cost and performance data for the two-year period to January 1960 are reported as follows:

Total coal consumption (both units), 26,472 tons; an estimated savings of 2,000 tons compared with other stokers in the same plant. Superior air zoning increases combustion efficiency at all loads. Average evaporation on one unit is 10.6 lb of steam per pound of coal and 10.8 on the other, using coals having an average Btu value of 13,173.

To cap it off, the company reports maintenance costs are much lower than those of other types of stokers in service, and . . . "efficiency and operating economies far in excess of the manufacturer's guarantee and our highest expectations."

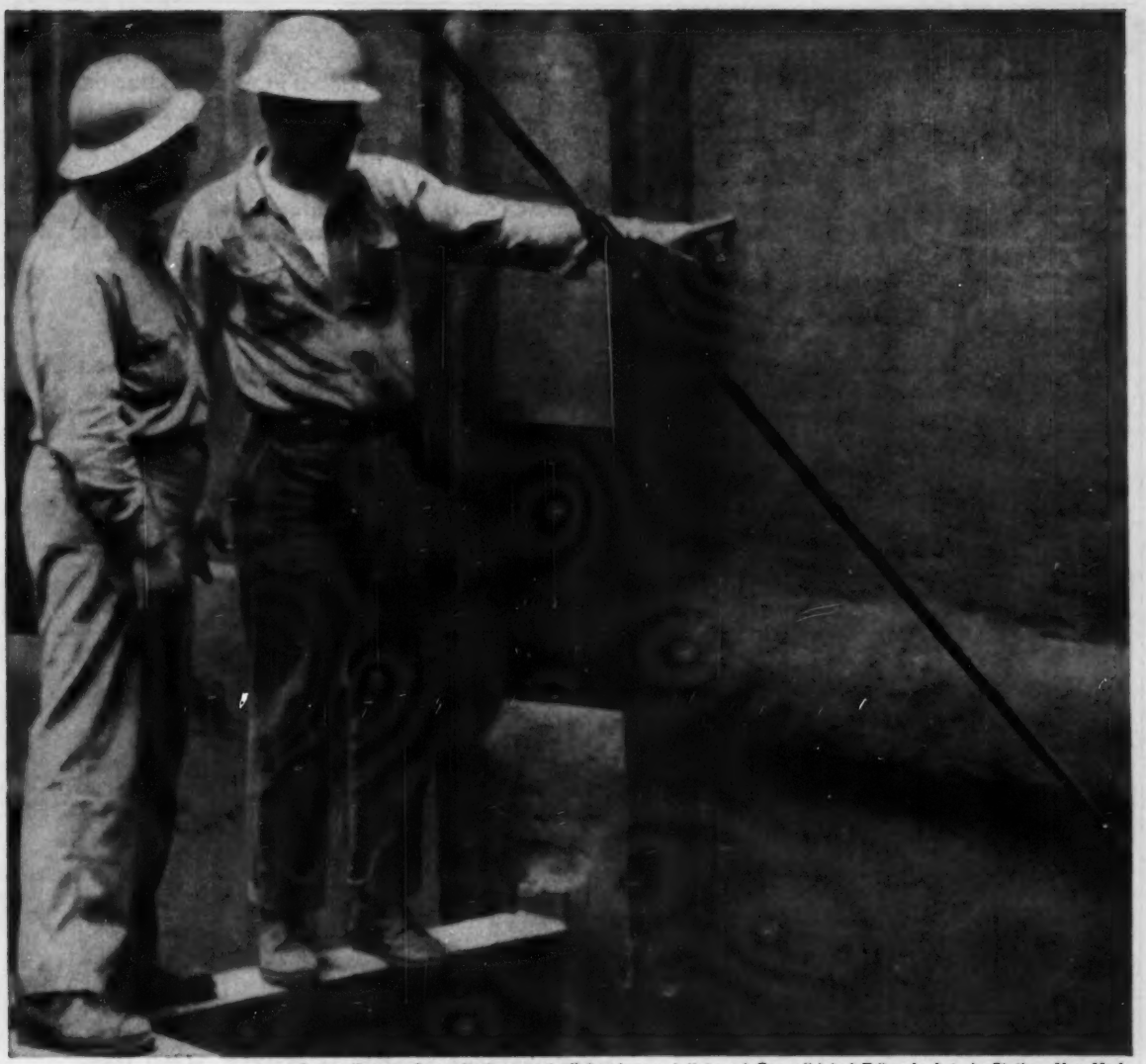
In every installation, and under the most critical observation, time and usage are proving the peak efficiency, and the almost total elimination of maintenance costs, possible with the exclusive AE Vibra-Grate Stoker design. No other stoker combines the advantages of vibrating grate feed, water-cooled grates and precision-controlled air zones.

Write to Dept. S-101 for copies of plant operating reports and AE Vibra-Grate Stoker Catalog S-100 today.

AMERICAN ENGINEERING COMPANY
Division of United Industrial Corporation
Wheatsheaf Lane & Sepviva St. • Philadelphia 37, Pa.

Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P. Q. • Bawden Industries Ltd., Toronto, Ont.

For more facts circle 346 on Reader Service card, p 103



Inspecting newly gunited concrete lining in precipitator at Consolidated Edison's Astoria Station, New York. **Contractor:** Research-Cottrell, Inc., Bound Brook, N. J. **Gunite Contractor:** J. A. McCollum, Inc., Marlton, N. J

Industrial concrete lining resists precipitator corrosion

Concrete linings of LUMNITE calcium-aluminate cement and aggregate are specified for power plant precipitators to protect against the corrosive effects of acid condensate and the abrasion of fly ash. Placement is fast, easy, economical – by guniting, pouring or plastering. Since the concrete reaches service strength within 24 hours, downtime is reduced. For greater convenience there are castables made with LUMNITE cement. These packaged mixtures, available from leading manufacturers of refractories, are ready to place when mixed with water. For more information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

"USS," "Atlas" and "Lumnite" are registered trademarks L-207

Universal Atlas Cement
Division of
United States Steel

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Griscom-Russell Evaporator Purities

Tests, recently conducted on a Griscom-Russell Bentube Evaporator in service at a large eastern utility, have shown that the G-R evaporator design consistently provides less than the guaranteed 1 ppm—as low as .005 ppm.

For full particulars on this test—the purities obtained, the importance of liquid levels and separators, and varying turbine loads, plus other useful information, contact your local G-R Representative.

This, and all the other information we have learned in our 90-plus years of engineering and manufacturing of heat exchange equipment, is yours, both as a service and as the basis for the design and construction of better evaporators, feedwater heaters, oil and air preheaters and coolers, and other heat transfer equipment for the power industry.

Specialists in the Engineering and Construction of Heat Exchange Equipment

feedwater heaters, evaporators, condensers, oil heaters, air, gas, and liquid heat exchangers—finned and bare tube, tank heaters, air-cooled fin-fan exchangers, sea water distilling plants, helically and longitudinally finned tubing, and many other products.

THE GRISCOM-RUSSELL COMPANY

MASSILLON, OHIO GR 401

A SUBSIDIARY OF HAMILTON-THOMAS CORP.

For more facts circle 349 on Reader Service card, p 103

George Edwards

asks: Is your child getting A's –and no education?

During a recent weekend at the home of a friend in the East, I heard a story that may interest those of you who have youngsters in high school or about to enter it. I won't identify my friend, nor his town, for reasons you'll understand as we go along. But I can tell you he's not the type to make mountains out of little bumps in the ground. Let's just call him "Pete" and let it go at that.

Pete's son graduates from high school this June. An honor student, he's in a dozen school activities. After supper the first evening I went along when Pete dropped him off for a class-play rehearsal. "I want you to see the school," said Pete. "Place was built about two years ago."

I was impressed, and said so as we drove back. "Yeah," Pete replied, "it's a beautiful plant. Cost a pile, too. Shame it isn't as good as it looks."

Back at the house, he told me what he meant. His boy's marks, high in grade school, skidded badly his first two years in high school. He always seemed to be busy with some school activity that took time from his studies. Pete got on the kid's back, said that he was in school to get an *education*, not for a round of extracurricular activities and social stuff.

"I told him I was all for it," said Pete, "provided he kept his grades up where they should be. And I harped constantly on this theme. If I'd been smart I'd have checked earlier than I did. But I didn't tumble until his younger sister was in her freshman year. She'd always been a fair student, but now she wasn't doing as well as she could, either.

"I did a little investigating and found that algebra was a complete mystery to her, and it wasn't entirely her fault by a long shot. But she was being taught, in great detail, such things as the intricacies of making fudge. She was getting A's in a vocal course, but I happened to know that she couldn't carry a tune in a bucket.

"The more I checked, the more I realized that my kids might get through high school, but they'd be about as ready for college as a couple of chimpanzees. In a nutshell, the school apparently wasn't interested in teaching the kids to *think*, allowed their time to be clogged with relatively useless stuff.

"I talked with *some* teachers who privately expressed discouragement with the setup, but they were over a barrel. My discussion with the principal was like punching a mattress. I came away feeling that he thought I was slightly nuts because I objected to my children getting a 'well-rounded' curriculum. To my question as to why a definite scholastic standing wasn't required for participation in extracurricular activities, his reply was, in effect, that the student should realize when he was getting in over his head.

"I came home and told my wife what we were up against. We realized that kids tend to take the line of least resistance, and the school was letting them do just that.

"We made up some ground rules for our children, and we made them stick. Studies came first. Other activities were privileges that must be *earned* by scholastic standing.

"The kids sure thought we were rough, at first, and I guess we were. But it has paid off. Now, they *like* it this way, are good students and are having more real fun than before. They're aware, too, of something that that school would never have taught them: As adults, they've got to be able to use the old gray matter, or be content with crumbs from the world's table."

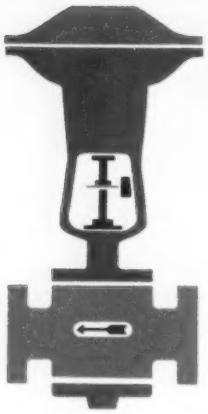
circle 350 on Reader Service card, p 103➤

when you're considering control valves, it pays to look at the whole picture!

How do you buy control valves? On price? On the basis of quality of materials and craftsmanship? On flow capacity, sensitivity or other performance characteristics? Sure, these are all important considerations. But no one of them *alone* offers a sound basis for evaluating control valves. You should take into account all of these factors, and many more . . . the whole picture.

A control valve is more than just hardware. It's actually the payoff point of your process. That's why it pays to consider other Honeywell factors, beyond the valve itself—things like process control experience, application engineering, and installation and maintenance supervision. The "whole picture" approach rewards you with best possible valve performance and better processing, regardless of your application.

IF YOU'RE CONSIDERING CONTROL VALVES, STUDY THE HONEYWELL PICTURE FROM EVERY ANGLE . . . YOU'LL FIND IT A BRIGHT ONE.



here's how Honeywell brightens the

Honeywell puts 75 years of control experience to work for you

Honeywell control valve know-how is the first big step in solving flow problems related to hard-to-handle fluids . . . corrosion . . . high and low temperatures. It's experience that started 75 years ago with the application of simple controls to simple processes. Today, this background helps put control valves to work in nuclear energy, missiles, industrial processing, utilities, and other areas.

Honeywell field engineers think in terms of the "whole picture"

Honeywell field men are more than just valve specialists. They're control engineers. Because they work with valves in their relation to the *overall* control system, they can help you get the very best from your entire system.

These eight control valves are representative of the broad Honeywell line.

Versatile, inexpensive . . . for general plant or process flows.

Self-contained, electric motor actuated . . . for plant service applications.

Tight-closing, Saunders type . . . for slurries or other hard-to-handle flows.

Small inner port area assures precise control of small flows in laboratory and process.

FREE VALVE DATA. The above valves, and many more, are described in our 84-page catalog. You'll find it a valuable reference source, too . . . including data on flow characteristics, corrosion, valve sizing, and other useful information. Write today . . . use handy coupon.

control valve picture for you!

Honeywell application engineers find the answers

The application engineers who back up our field men are experienced in tackling the toughest control problems. They study your flow conditions, performance requirements and potential trouble spots—and find the right answers in terms of correct control valve application.

Honeywell builds extra quality into control valves

Each Honeywell control valve is the product of first-rate materials, precision machining, careful assembly, and the most rigid testing and inspection imaginable. You can rely on them for long, low-maintenance service—and, for all their ruggedness, they're built to operate with the precision of a fine instrument.

Honeywell delivers on time

You'll like the completeness and "on-time" aspects of Honeywell service. Each order is double-checked against your final process requirements before it's shipped. Stocks of the most commonly used valves and parts are always kept on hand, ready to meet your deadlines.

Honeywell helps install and maintain your control valves

Your local Honeywell service engineer can lend you an experienced hand in installation and startup of your system. Honeywell control valves rarely require any more maintenance than an occasional check of the packing box. But should any trouble arise, a call to your Honeywell branch will bring help on the run.

Split-body simplifies maintenance in control of "problem" fluids.

Balanced, three-way operation . . . ideally suited to mixing or diverting.

Special features and accessories . . . for high temperatures and pressures.

Angle-body, electro-pneumatic positioning . . . exemplifies flow and control versatility.

75th YEAR

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we'd like to start working for you right now

HERE'S THE VERY FIRST STEP TOWARD BETTER CONTROL
Fill in this coupon and return it to Honeywell's Valve Division

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Put our team of experts to work on your control valve problems right away. You'll find that Honeywell's Valve Division is a reliable source of competent engineering assistance and excellent products. Tell us about your application today.

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Valve Division, Fort Washington, Pa.

Honeywell

First in Control

SINCE 1885

Power for Toquepala

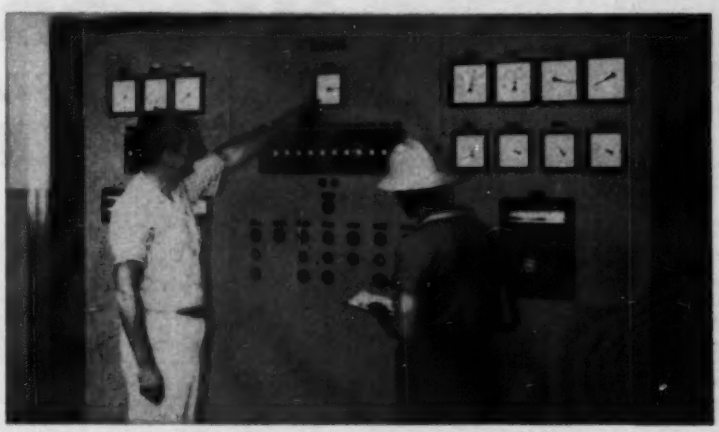
...an example of global engineering by Brown Boveri

BROWN BOVERI

Today American free enterprise is finding opportunities all over the world. And wherever in the world these opportunities are to be found, chances are Brown Boveri is there already with factory-trained specialists, company-owned production and service facilities and the precious advantage of local know-how and engineering experience.

In planning the gigantic Toquepala project, the combine headed by American Smelting and Refining Company and its consulting engineers, Stearns-Roger Mfg. Company, turned naturally to Brown Boveri for the power supply. In Peru, nearly all large turbo-sets are Brown Boveri-built and our company there is an established service organization with resident engineers available anywhere in the country.

Look where you will the story is the same – be it gas turbines in Arabia, rectifiers in Rhodesia, switchgear in India, a turbo-compressor in Pakistan, power line communications in the Congo or mining operations in Arizona or Toquepala—it's routine for Brown Boveri.

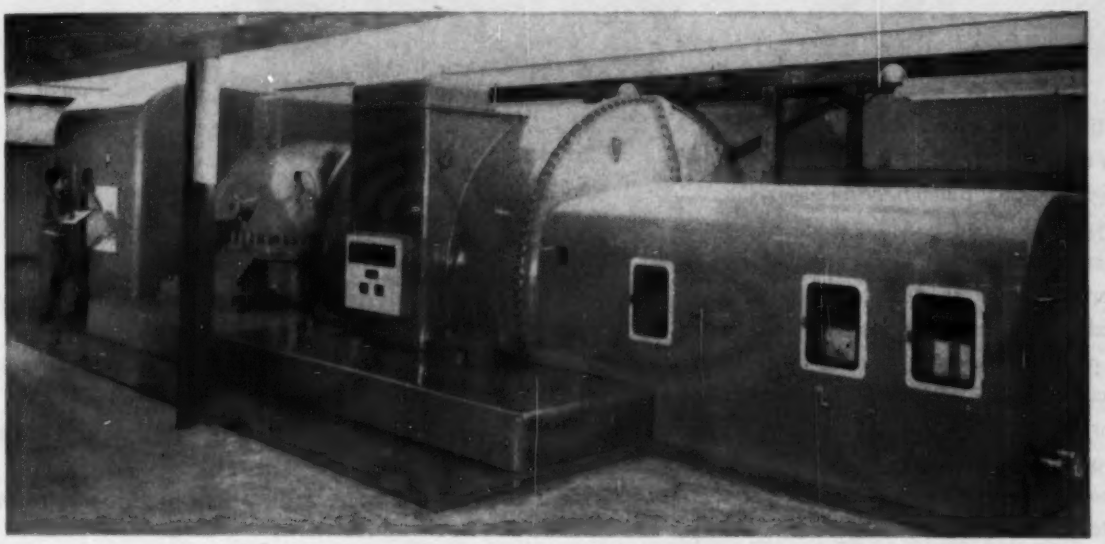


Control panel for one of the Brown Boveri turbine-generators.

Over 80% of the production of Brown Boveri's great Swiss works is exported and we maintain production facilities, sales and engineering offices in over 65 countries with close to 70,000 people on our payroll.

If you are thinking of an overseas project of any kind, we invite you to draw on this unique experience in global engineering. We think you'll be glad you did.

Brown Boveri builds steam and gas turbines, boilers, condensers, generators, transformers, switchgear, rectifiers, motors and complete rolling mill drives, compressors, electric furnaces, betatrons, induction heating equipment, communication equipment.



One of two Brown Boveri 20/22 MW Preferred Standard steam turbine-generators at Toquepala copper smelter in the Peruvian Andes. Generators are 60 cycle, 3600 rpm.

They power huge electric stripping shovels, smelter blowers, crushers, separators and other heavy mill equipment . . . and two company housing projects.

This is the biggest thermal station in Peru. Brown Boveri also supplied the two main condensers, the dump condenser and the air ejectors.

BROWN BOVERI Brown Boveri Corp., Dept. P-5, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.

For more facts circle 351 on Reader Service card, p 103

WHERE "BUFFALO" TYPE "CR" FANS MEAN

MAJOR DRAFT SAVINGS

RIGHT FROM THE START

* *The "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.*

Utilizing a superior radial-tip blade wheel in the same stream-lined housing as the high-efficiency Buffalo Airfoil series, the Type "CR" Fan provides highly satisfactory performance in many punishing applications . . . at lower first cost. For example, its rugged construction and abrasion-resistant qualities make it a popular choice for handling fly-ash in power plants. Further, Buffalo Radial Blade wheels are available in varying widths and depths to meet most pressure-volume requirements efficiently. Write for Bulletin FD 205 and check the "Q" Factor* Features that make Buffalo Mechanical Draft Fans the best buy for your service.

- **Stable performance with or without fixed inlet vanes.**
- **Rising horsepower characteristic for efficiency at dampered ratings.**
- **Excellent for I.D. on stoker-fired or pulverized coal boilers.**
- **Use of smaller fan size possible on many direct-connected installations.**

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Buffalo, New York
Buffalo Pumps Division • Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING
FORCED DRAFT • HEATING • COOLING • PRESSURE BLOWING

For more facts circle 352 on Reader Service card, p 103

STEVE ELONKA
Associate Editor in Charge

ON-THE-JOB TRAINING added to related classroom lessons during the four years, plus 20 units of junior-college credits taken on their own time, entitles these bright apprenticeship trainees to an associate of arts degree from San Diego Junior College

Convair trains 'em for . . .

Plant engineering maintenance

By CHARLES KILDGORE, Assistant Supervisor, Plant Engineering Convair (San Diego) Div of General Dynamics Corporation

To keep abreast of maintenance techniques needed in our increasingly automated aircraft plants, the Plant Engineering Dept of Convair (Div of General Dynamics Corp), San Diego, Calif., runs personnel-training programs in industrial electricity, electronic-control, mechanical and refrigeration maintenance. Where possible, instruction supplements on-the-job training at the most opportune time, making our total program more effective. For the young man aiming at a career in engineering, this is the best possible place to learn the practical side of the profession—and our trainees find it so.

Industrial-electricity program is based upon an agreement between our employees, the company, the union and state and Federal Apprenticeship Training Coordinating Agencies. By mutual consent, the curriculum provides a given number of hours of training, part of them spent in the class-

CLASSROOM WORK in electronics is given by highly skilled instructors to plant-engineering electricians. Trainees go on to maintain complex electronic control systems

REFRIGERATION on-the-job training is done on units from ½ up to 1000 ton

Here's the program that keeps complex plants running smoothly

room. Apprentice works at assigned jobs, using the materials, tools and equipment of skilled journeymen on actual jobs. He gets related technical classroom training.

Joint Apprenticeship Committee administers the program, meeting once a month. The committee is composed of eight members, two company and two union representatives acting with vote; one journeyman, one school representative, one consultant from the Bureau of Apprenticeship and one apprentice-training coordinator. This committee decides the eligibility of applicants, what credit or allowances will be made where applicant has related practical training experience. It also periodically makes a detailed review of performance of the apprenticeship program and training.

Eligibility. To be eligible for apprenticeship training, applicant must (1) be between 17 and 26 years old (2) be a high-school graduate (3) be mechanically inclined (4) be able to benefit by the training, and (5) pass certain aptitude tests. Besides, a written agreement setting down the terms of the program must be signed by applicant (and by his parents or guardian if he is a minor) and a representative of the company and the union.

Agreement provides for a probationary period of 500 hr (three months) for each apprentice, during which time either party can terminate the agreement. Then the apprentice serves four years, or about 8000 hr, including school time and probation period. During this time, his work is periodically reviewed and he is advanced in the trade. Applicants with related practical experience may be allowed credit up to one year or 2000 hr.

The 8000-hr program used in training industrial electricians is shown on right-hand page. Division into hours permits any changes needed for flexibility.

Graduation. On successfully completing the program, each apprentice is issued a certificate of journeymanship. Apprentices desiring further study during their apprenticeship may earn up to a total of 44 units of junior-college credits for their on-the-job training and related technical instruction. This means that with an additional 20 units of junior-college credits taken on his own time, apprentice can earn an associate of arts degree from the local San Diego Junior College.

Electronics training. Our plant-engineering department also holds scheduled classes for maintenance of electronic control systems. Instructors in electronics are highly skilled employees. Aim is to provide a thorough working knowledge of electric and electronic fundamentals. Emphasis is on electronic systems most in use, new developments and special systems.

Besides highlighting general problems that come up in maintaining electronic control systems, training promotes better communication between shifts. It also stimulates trainees to think of adjustments in relation to machine's compliance with programed control.

Training is given to an average of 20 to 25 electricians in each scheduled class. Limited learning capacity of some attendees because of age, past work experience, disinterest or lack of formal education is taken into account for maximum benefit.

Our experience shows that while all trainees do not acquire the needed skill or knowledge to maintain electric control systems, they do acquire a sympathetic appreciation of the problems involved in such maintenance. This training also establishes a highly important reservoir of personnel trained in maintenance.

Instruction. First part of the class instruction is a preparatory review of basic mathematics and principles used in electricity. Theory of the mathematical and basic principles of electronics is then explained by comparison with use in electrical circuits.

When the class has advanced enough in review, a specific type of electronic control system is studied. A machine utilizing the system under study serves as an instruction tool. This machine is usually in service in production and can be studied by the class under designed operation for best possible results.

Outline on opposite page, bottom, shows the 2-week course we use to teach the maintenance of Electronic

Control Systems Digimatic 180 Tape Control Unit. This is a numerical control system designed for automatic control of a heavy-duty 3-axis machine tool. Contour-milling and vertical-profiling machine-tool operations may be performed on all types of ferrous and nonferrous materials with an accuracy of one-thousandth of an inch. Control and machine-tool system may be used in manual-, power- or tape-control modes of operation.

Periodic seminars are arranged within the department after training is completed to analyze specific maintenance experience and problems. Sharing in discussing the solution to one man's problems benefits the other trainees. Many of them may run into similar problems. Seminar provides additional preparatory instruction as a refresher course, especially for the employee who was reassigned to another job.

Mechanical and refrigeration maintenance training includes discussing production equipment such as the Hufford stretcher, Onsrud mill, Cyril bath, King boring mill, Bellevue furnace, high-speed wind tunnel and Scotchweld. These rely on both electronic and mechanical controlling components for their operation. A higher degree of skill than normally found in an average shop is needed for good maintenance here. Our refrigeration-maintenance personnel are called upon to maintain air-cooling equipment ranging from electronic-controlled 1000-ton absorption systems to half-ton window units.

This maintenance interdispersing requires our mechanical and refrigeration personnel to possess a working knowledge of electronic-control principles. And our electronic-maintenance personnel must know mechanical and refrigeration maintenance. Classes for maintenance of specific types of equipment are given as needed. Length of each instruction period varies with complexity of equipment. If equipment is electronically controlled, an electronic-maintenance person is assigned along with trainees of mechanical-refrigeration maintenance.

On completing training, mechanics and electronics-maintenance personnel work together, instructing each other. We have found that on-the-job training acquired this way increases efficiency.

Mechanical and refrigeration personnel who have not attended scheduled classes are assigned to work with and be instructed by a previously trained mechanic who has attended these schools. This on-the-job training gives the man advanced knowledge of maintenance problems of a particular machine prior to classroom instruction. Another benefit: he is more receptive to training when later scheduled to attend a regular instruction class or seminar. And it adds to our maintenance-instructor potential by contributing to our reservoir of trained mechanical- and refrigeration-maintenance personnel, which is highly important in planning for the future.

When an understudy has acquired enough knowledge and skill to do his own maintenance he is replaced as understudy by a new trainee. He may become the new trainee's instructor, increasing his own understanding.

Our training program for maintenance personnel is under constant review. We keep trying new methods to increase our maintenance potential in the ever-expanding design of modern high-production equipment. In an industry as complex and dynamic as ours, constant change demands that each employee keep up to date.

Industrial electricians get 8000 hours of on-the-job training

Knowledge of electrical materials—200 hr
Issuing, ordering and stocking wiring materials

Care and use of tools and equipment—80 hr
Familiarization with proper care and use of fish tapes, dies, pipe-threading machines, hydraulic and hand benders, safety belts, ladders, chipping hammers, star drills, knock-out cutters and other tools of trade

Maintenance, repair of electrical equipment—400 hr
Lamping; repairing scatter boxes, extensions, lighting fixtures; locating, cleaning and repairing troubles on lighting and appliance circuits; maintenance and repair of small motors; repairing controllers

Blueprint reading and j-b layout—520 hr
Taking material from print; using knowledge of stock room; getting material to job site; planning job layout; recognition of wiring symbols; checking circuiting, wire sizes, services and feeders. Application of national, state and local codes and safety orders, observation of these rules in practice, their practical purpose and reasons

Industrial lighting and appliance wiring—1000 hr
Steel-tube bending and installation, condulets, outlet boxes, wiring gutter, load centers, wire pulling, circuiting, making splices, hanging and connecting fixtures, installing switches and convenience outlets

Motor repair and rewinding—1000 hr
Coil making, insulating, connecting and testing motors

Outdoor light and power—500 hr
Flood and area lighting, time switches, pole-line construction, overhead power-distribution servicing, maintaining transformers

Wiring for industrial light and power—2500 hr
Power wiring in conduit, bus-duct wireway, etc; distribution panels, switchboards, oil and air circuit breakers, transformers, large motors, capacitors, bus-bar bending and installation

Metering, control and instrumentation—1800 hr
Current and potential transformers, inverse-time-limit relays and settings, remote control and protective devices, sequence operation, time delay and limit switches, panel wiring, heat-treating instruments and control, thermocouples, distant-reading thermometers and their calibration, control valves, thermostats, pressure switches, modulating control, air-conditioning control

Electronic-control-system course takes two weeks

Monday—Introduction: (1) review (2) digital-control system (3) tape (4) programing

Tuesday—Theory of operation: (1) block diagram (2) transducers (3) counter tubes

Wednesday: (1) demodulators (2) pre-amplifier and pulse shaper (3) mixer logical block diagram

Thursday: mixer logical block diagram—(a) introduction to logical circuits (b) Boulean algebra notation (c) motion digitizer logic

Friday: mixer logical block diagram—(a) review of motion digitizer (b) motion and command mixer logic

Monday: (1) mixer circuit diagram with the aid of logical block diagram (2) mixer self-test features

Tuesday: error register—(a) block diagram (b) counting logic (c) self-test features

Wednesday: (1) auxiliary functions—(a) tape signals (b) relay driving circuits (c) relay operations (2) test panel (3) relay chassis

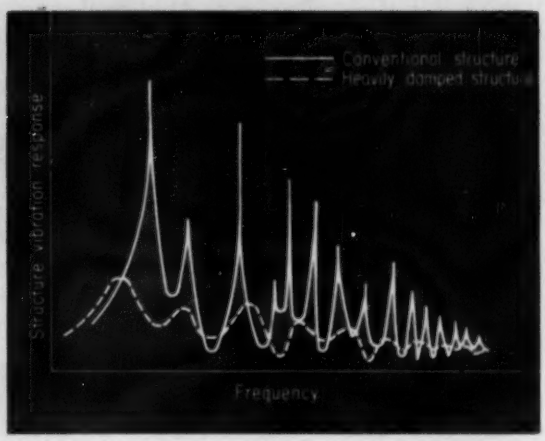
Thursday: (1) tape transport (2) servo drive system (3) homework assignment—operational difficulties to be solved with the aid of the mixer logical block diagram

Friday: (1) review and discussion (2) each student explains mixer logical block diagram in his own words

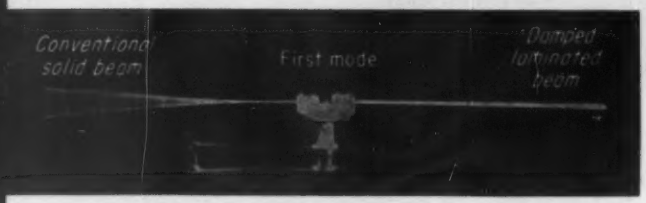
OPERATORS' NOTEBOOK 139

Damped

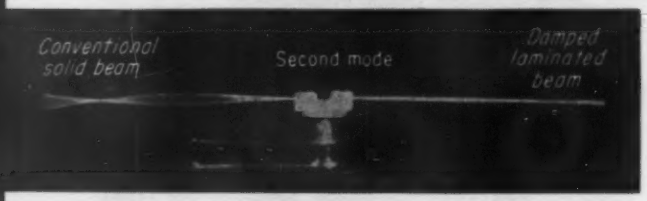
COMPARING VIBRATION of the undamped beam, left, internally damped beam, right, at same resonant frequency



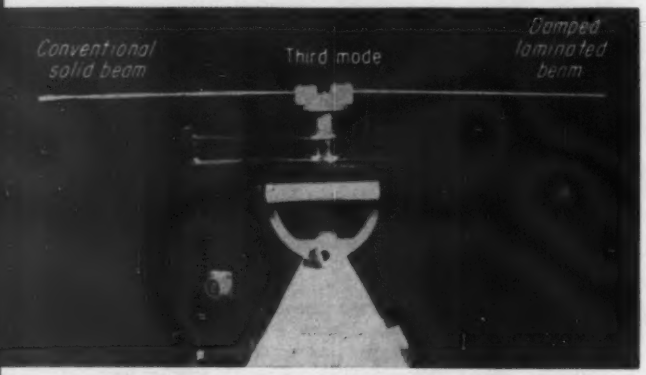
STEADY-STATE vibration of undamped and heavily damped beam points up difference. Both are functions of excitation frequency



SINUSOIDAL vibration input at 17 cps; here conventional beam, left, amplifies vibration by a factor of over 100, the internally damped beam, right, by a factor of only about 10



FIRST HARMONIC frequency of 105 cps; vibration amplification of conventional beam, left, exceeds 100. Factor of the internally damped beam, right, is down to about 3



SECOND HARMONIC of 300 cps; internally damped beam, right, appears stationary to the naked eye. Amplification of conventional beam, left, is actually about 50 times as great

Vibration troubles? Try

Latest way to reduce vibration in all types of modern high-energy power plants is to build damping characteristics right into the structural fabrications. Resonant vibration may be cut down so much that vibration isolators aren't needed.

Photos shown here were taken at Barry Controls, Inc, Watertown, Mass. The Barry people developed, and now engineer and fabricate, these new structural members.

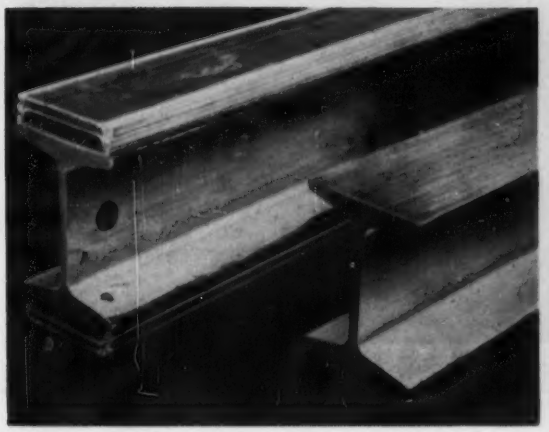
Built-in damping was developed because structure amplified power-source vibration in aircraft and missiles, creating large dynamic stresses. Besides transmitting high accelerations to sensitive and critical parts, vibration produced fatigue, brought up serious structural-failure problems. Low structure-vibration response of new members compared with response of conventional members is charted, in graph, above.

Photos, left, show two simple cantilever beams mounted in a vibration exciter. Beam on left is solid aluminum, other has damping characteristics built into it. Both are tuned to same resonant frequency. But the damped beam at right resonates far less than the other. Action shown is at two beams' fundamental resonant frequency and at their first and second harmonics.

Other damped structural forms, shown above right, are the more common shapes—channels and I-beams. Their usual resonant response is said to range only from 5 to 10 times the excitation vibration found in modern dynamic environments. This compares with 60 to 300 times for common structural materials and from 30 to

structural members help lick vibration

By STEVE ELONKA, Associate Editor



DAMPER at left has been applied to a standard 3-in. aluminum I-beam. These dampers interlock in building-block fashion

ALUMINUM I-BEAM has 14 steel inserts. Aluminum channel has one insert, rectangular section has four steel cell inserts

structural members with built-in viscoelastic damping

100 times at resonance for small welded or riveted pieces.

Built-in damping is the answer. Sheets and thin-section beams are laminated with metal or plastic, separated by a viscoelastic damping medium. In flexing under the impressed vibration, the laminations slide relative to each other. But sliding is impeded by the viscoelastic material, and most of the energy of resonance is absorbed in straining this layer in shear.

Other structural shapes such as I-beams, channels and angles are of cellular design rather than laminar. Longitudinal cells are formed through the entire length; each cell has an insert separated from cell walls by viscoelastic material.

According to Barry engineers, this is the first design in which all portions of the structural fabrication act as load-carrying members. An added advantage: materials and structures can be designed for optimum damping characteristics in all normal frequencies.

Fixes. For existing equipment and systems where vibration causes trouble, damped members are also suited for use as "fixes" to reduce the resonant response of conventional structures. Just as foil damping tapes are used for "fixing" large areas, strip damper of cell-insert construction can damp long structures. Strip dampers can also be used as building blocks in experimental design work—for obvious reasons.

Fatigue life of a damped member should be longer because stress level is reduced. Besides, these damped pieces are not sensitive to changes in vibration input and operate well across a wide range of frequencies. Pieces with built-in damping characteristics have an extremely flat vibration response up to 2000 cycles per second.

Disadvantage is that a member thus damped has less load-carrying capacity than an undamped member of the same material and cross section. To produce equal stiffness, structural damping imposes a slight increase in weight. For same cross section load capacity is cut.

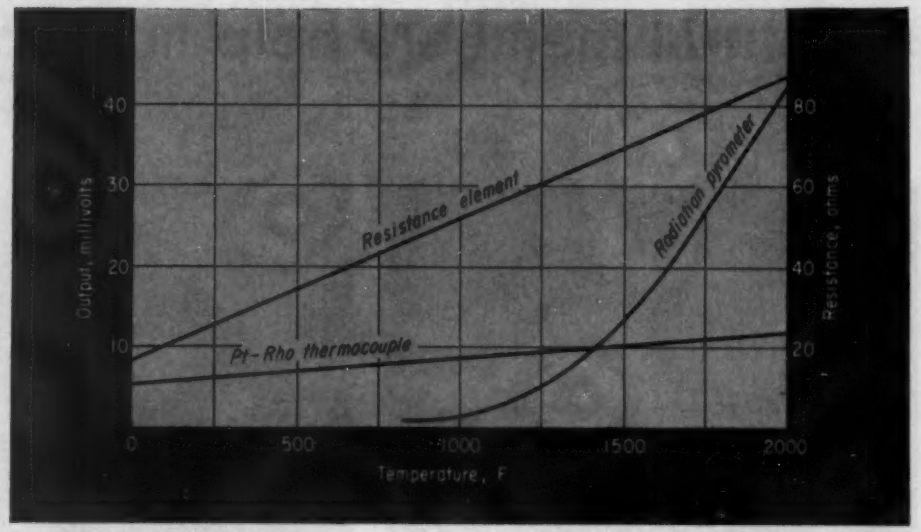
At present, big applications are in the electronics, missile and aircraft industries. But damped members can be applied to large or small structures wherever vibration problem is severe enough to warrant their use.

Until recently, accepted practice combined conventional structural designs with isolators. One reason: problem of dynamic response was limited to fairly low frequencies. But modern designs seek low noise, light weight, increased reliability and long life—all at much higher operating speeds, much higher frequencies. Conventional designs cannot always meet these extremes.

Today, there are six possible ways to avoid damaging resonance conditions: use (1) vibration isolators (2) more rigid structural members (3) decoupling resonating systems (4) detuning coupled resonators (5) high-fatigue-strength structural materials, or (6) incorporate high-energy-dissipating mechanisms, such as the ones featured in this article, in the structural members.

Because these new damped structural members can dissipate large amounts of energy, they should do a real job reducing vibration in the modern plant.

PERFORMANCE TESTING NO. 4



TEMPERATURE CHARACTERISTICS of thermocouple, resistance element and radiation pyrometer show enlarged measurement increments now available for precise test thermometry in high-temperature ranges

New ways to measure temperature

New elements, refractory metals, sheathed thermocouples promise greater accuracy at ever-higher temperatures

By L E STEWART, Associate Editor

Increasing demand for high-accuracy performance data keeps plant engineers on the hunt for rugged, precise measuring instruments. The hunt has been especially frantic for elements to measure high temperatures—1000 F and above. To help you select test equipment for this working range, this fourth article in POWER's performance-testing series outlines some recent trends in element use.

Operating problems are major factors in design and application of test equipment. In high-temperature measurement, problems usually are compounded by corrosive or erosive atmospheres as well as effect of heat on elements' electrical properties.

High-temperature measurements usually crop up in monitoring flue gas or other combustion products, steam and some thermal liquids. In the past, these measurements required extremely accurate thermocouples, homemade and calibrated in the plant. System was unsatisfactory for three basic reasons:

1. Extensive handling of the homemade couple during formation of the hot junction and during calibration frequently damaged leads or junction, producing early failure.

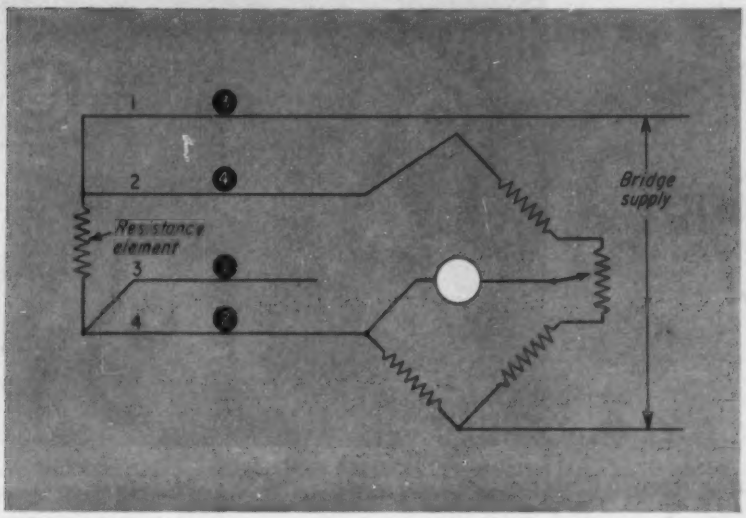
2. Since labs would not calibrate finished couples, but merely representative strands of wire, a plant's secondary standard became the only available reference for test couples.

3. Homemade couples suffered from inadequate protective covering, failed sooner in rugged test work.

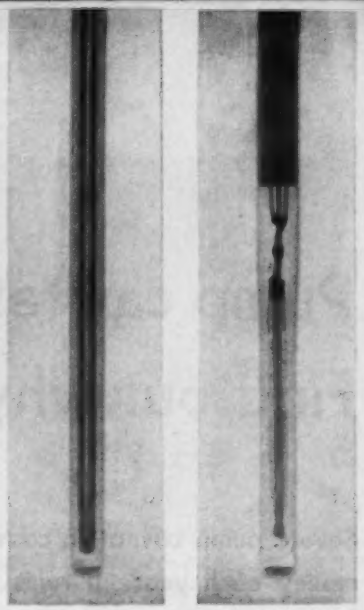
New elements used for performance-testing work begin to solve the problems of homemade couples through use of manufactured hot junctions sealed in metal sheaths. In many cases, results engineers are ordering test thermocouples with cold junctions molded into rubber tubes for increased protection. In addition to improving life of ordinary test thermocouples, metal sheathing permits test use of other types of temperature-measuring elements. Chart, above left, shows thermocouple emf for Pt-Rho elements, and resistance thermometer element's rate of change plotted for the same temperature range. Greater sensitivity to change shown by the resistance element makes it extremely useful as a test unit. But the tiny platinum-wire element was a delicate item for the rugged conditions of most test work. Thermowell or gas-probe vibration coupled with elevated temperatures caused many elements to fail.

Sheathed thermometers, packed with refractory powder such as alumina, withstand considerable knocking about as well as corrosive atmospheres. X-ray photo, top right, shows internal construction of typical thermocouple and resistance thermometer, both designed for testing. Resistance elements have been used in lower ranges for some time; now improved stability plus added sensitivity to unit temperature change makes them handy for high-temperature thermometry.

Calibration of the new test elements calls for an accurate secondary standard. This may be kept in the plant if you do sufficient work to justify owning standard equipment. Thermocouple calibration may consist only of an accurate check at one



BRIDGE CIRCUIT used to measure changing resistance of platinum element supplies precise readings of temperature. Alternate lead connection checks calibration readings



X-RAY VIEWS of sheathed thermocouple and resistance element show new designs

temperature level. If the test couple is to be used for measurement of some nonvarying temperature, calibration at that temperature should be sufficient.

Resistance elements can shift calibration with use, but new encased elements have little drift and tend to show a uniform translation of the calibration curve over the entire temperature range. For periodic test use, a check against the freezing point of water (pure condensate, please!) will indicate drift. Test units should be calibrated on a predetermined basis which is followed rigorously.

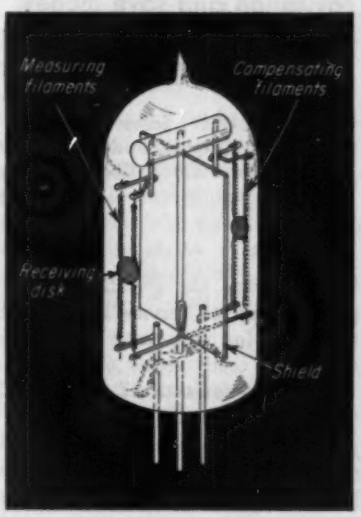
Current practice in thermocouple calibration is based on a double standard of checks after a specified number of hours in use or after a specific number of temperature cycles. Although drift of resistance elements is similar to thermocouples', the ease of checking against one low-temperature point permits more-frequent calibration without added effort.

Lead resistance becomes an important question in resistance-element calibration, particularly with long leads. To compensate for errors in element calibration, bridge circuit, above, used to measure resistance is connected first as *1-2-4* and secondly as *2-3-4*. Fourth lead, for calibration checks, is not used for in-operation temperature measurements.

As higher temperatures become a standard part of plant operation, even-newer equipment is coming into use in plant testing. For temperature measurements where optical systems can be used, test engineers may read radiation energy level with standard wire comparison element or an instrument using the bolometer shown at right. In operation, bolometer is energized by radiant energy focused on receiving disk. Heat of disk is detected by measuring filaments (resistance elements) and transmitted as Wheatstone bridge unbalance. This instrument usually covers a range of 1000 to 3000 F.

Refractory-metal thermocouples are beginning to show up for temperatures in the 2000- to 4000-F range. Experimental work recently completed on rhenium-tungsten thermocouples, operating in a hydrogen atmosphere, indicated acceptable stability under extreme temperature conditions. Drift at 4000-F level was held as a constant value over the temperature range. Drift increased with time of exposure to 4000 F, but the incremental drift decreased with each successive temperature cycle.

Other refractory-metal thermocouples are currently offered in molybdenum-rhenium and iridium-rhodium combinations. Temperature-emf curves for all the refractory metals are still tentative, consisting of data obtained by various research laboratories working on separate projects.



BOLOMETER TUBE is operating heart of compact, direct-reading radiation pyrometer

Temperature measurement in the range above 1000 F introduces many problems for the performance engineer. Even within the relatively common range of 1000 to 2000 F, truly precise, repeatable results are hard to come by. However, the problem is somewhat simplified if you obtain the best-possible temperature element and maintain it in top operating condition and perfect calibration. Don't try to save money in instrumentation at this point—you'll nullify all other efforts to get accurate results.

Pump cavitating? Find out why!

Severe pump cavitation costs users big money each year. It ruins more centrifugal-pump impellers than any other hydraulic factor. Know how to avoid cavitation and save money

By R K DELANEY, Sales Engineer
Peerless Pump Hydrodynamics Div
Food Machinery & Chemical Corp

MEDIUM-SPECIFIC-SPEED IMPELLER was severely damaged by prolonged cavitation. Damage is confined to inlet vane area

Cavitation is the gremlin cutting into a centrifugal pump's expected service life. If you allow your pump to cavitate for long, result can only be premature failure, calling for costly repair or replacement.

What is cavitation? It is the formation and subsequent collapse of vapor bubbles due to momentary pressure reduction. Within a centrifugal pump, point of lowest pressure is at impeller eye since this is also point of maximum velocity. To form these bubbles or vapor cavities, pressure must drop below that corresponding to saturation temperature of liquid, causing it to flash. Actual cavitation damage is due to collapse of bubbles. As pressure rises again through impeller passages, vapor cavities or bubbles implode — violently enough to actually tear away minute bits of metal. Metal areas near the point of bubble collapse ultimately are eaten away and evidence of prolonged cavitation is clearly seen, photo above.

Manufacturer's rating curves normally show required npsh plotted against capacity. Using formula, opposite page, you can figure the npsh you have available in your system at all flows to be encountered. Figure the value at several flows and plot a curve vs capacity. Then compare with manufacturer's pump-rating curve and be sure that yours exceeds it at all flows. Also be sure that there is some margin of available over required npsh to allow for errors in calculation, the effects of sudden suction-system changes or capacity increase.

What causes cavitation? Pressure reduction can be produced several ways. If actual capacity or speed is higher than design, resulting increased velocity and friction losses in the suction system cause increased pressure drop—perhaps large enough to produce cavitation.

If the pumping temperature is boosted without a corresponding increase in pressure, available npsh to pump is reduced—perhaps enough to cause cavitation.

If suction-system losses are increased (by a partially closed suction valve, for instance), available npsh can be greatly reduced—perhaps causing cavitation.

How can you tell if your pump is cavitating? Any one or all of three things can tell you:

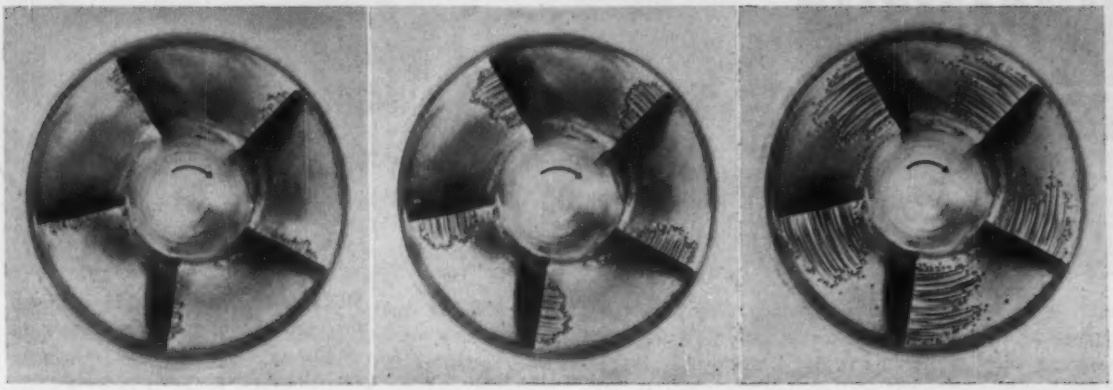
(1) If the pump is noisy (crackles and sounds as if it's pumping marbles) and vibrates you should look for cavitation. Test: Admit a little air into the suction line; this will quiet down cavitation noise and reduce vibration by forming a cushion of air bubbles. Air bubbles absorb shock of vapor-bubble collapse.

(2) If developed head and capacity do not agree with pump curve supplied by the manufacturer, check for cavitation. Formation of vapor bubbles limits pump capacity to some maximum value regardless of developed head. In higher-specific-speed pump types, reductions in head frequently occur throughout capacity range of pump. Efficiency reductions become pronounced in this type.

(3) If physical damage to the impeller inlet vanes is noted, pump is probably cavitating. Damage results from localized removal of metal and formation of pits. Pitting becomes more rapid with increased temperature and total failure occurs sooner. Cavitation damage can usually be distinguished from damage due to erosion or corrosion. Latter damage extends throughout impeller waterways while cavitation damage usually will be confined to impeller inlet vane areas.

What can you do when you face a cavitation problem? There are several possible solutions. You should first try to nullify the cause of cavitation. Check suction-line losses. Are they higher than necessary? Is the suction valve partially closed? Can pump capacity be conveniently controlled within npsh limits? Sometimes this is possible in "on-off" operations where the "on"

Don't let this happen to your centrifugal pump



CAVITATION point moves farther up the impeller vane with decreasing pressure. Pictures were taken of a running pump impeller (medium specific speed—mixed-flow type) through a plastic plate. Areas of bubble collapse are faithfully shown

time can be increased to reduce pump capacity required.

But if all means taken to increase available npsh in the suction system fail to eliminate cavitation, pump manufacturer may be able to provide a different impeller design to operate satisfactorily with the existing system.

Obviously the impeller material has some effect on extent of damage. Harder materials withstand the damaging effect of cavitation better. Stainless steel, for example, will last longer than bronze. Remember that in a multistage pump only the first stage cavitates. So you won't have to change material in all stages to reduce the damage of cavitation. Although this solution may be only temporary, in some cases it may well be the best available—if others are too costly to be practical.

One exception should be mentioned. Certain pump designs are made to operate while cavitating, and their capacity is actually controlled by the suction level. These are usually small low-speed condensate pumps with very low npsh requirements. Here, the inlet eye is oversized to reduce velocity and minimize effects of cavitation. This specialized pump will have satisfactory life even when constantly cavitating during operation.

Here's how you figure pump characteristics

Npsh—Net positive suction head

Npsh is a measure of pump suction conditions common to both pump manufacturers and users. It eliminates confusion arising from different interpretations of such old terms as *suction lift* and *suction head*. For any suction system *npsh* in ft of liquid pumped is:

$$npsh = \frac{(p - p_v) \times 2.31}{sp\ gr} \pm z - h_d$$

where:

- p = pressure at liquid surface, psia (atmospheric pressure in open tanks)
- p_v = vapor pressure of liquid at pumping temperature, psia
- $sp\ gr$ = specific gravity of liquid pumped at pumping temperature, expressed as a decimal
- z = static elevation difference, ft, between liquid level and center line of horizontal pumps or first-stage impeller eye of vertical pumps
- h_d = sum of dynamic losses in suction system, ft. These include pipe friction and entrance losses

N_s—Pump specific speed

All centrifugal pumps have a particular design specific speed. It does not change with running speed since other factors in its calculation also change a proportional amount. It does change slightly with impeller cut-down since this is a dimensional change. By knowing the specific speed of a pump, you can tell many of its characteristics, such as shape of performance curve and probable impeller type. Specific speed is a dimensionless number and is figured:

$$n_s = \frac{\sqrt{q} \times rpm}{h^{\frac{3}{4}}}$$

where: q = capacity at point of best eff, gpm
rpm = rated speed
h = total head at point of best eff, ft

Centrifugal-pump types operate in the following specific-speed ranges. Note that there is some overlap:

Pump type	*Specific-speed range*
Radial flow	500 to 3000
Mixed flow	2500 to 7000
Axial flow	6000 to 15,000

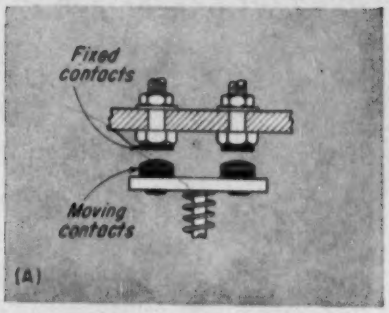
Plant Electrical Fact File

NO. 47: CONTACTS

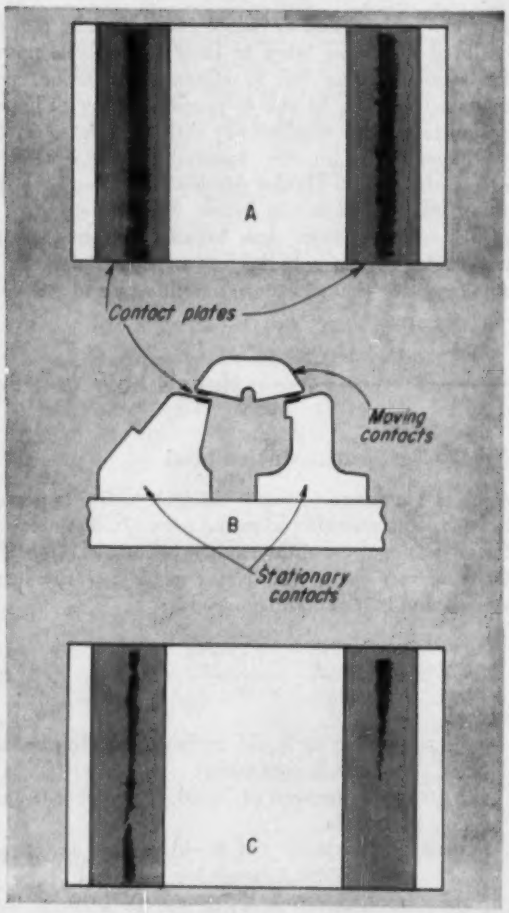
Pointers on contact maintenance

By NORMAN PEACH, Associate Editor

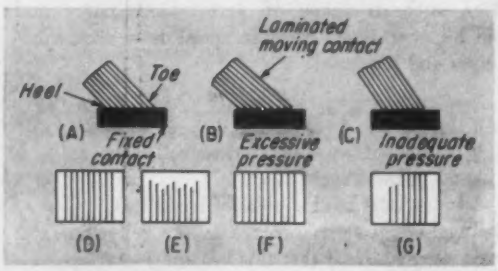
Starters, controllers, circuit breakers and relays make use of contacts in one form or another. Contacts are liable to deteriorate because of wear, burning, insufficient pressure, formation of high-resistance surface films; they may be scored or welded together by excessive current. Regular inspection and proper attention can circumvent these headaches. While different contact materials require somewhat different treatment, a few general rules will provide basis for trouble-free contact operation



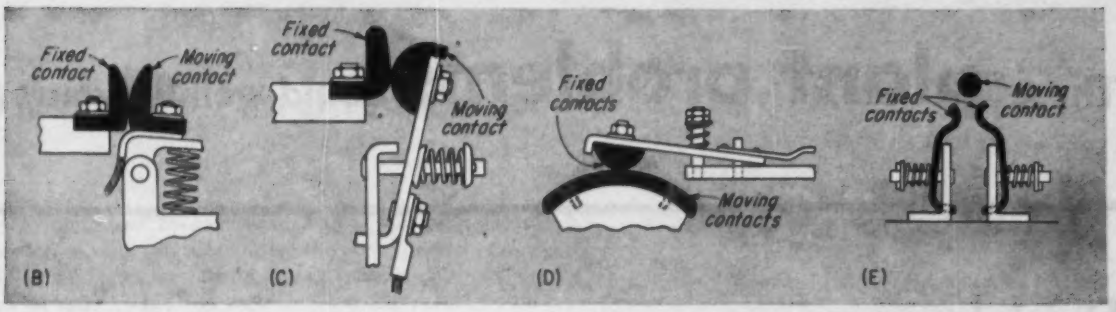
SILVER-ALLOY CONTACTS are used for vertical motion where there's no wiping or rolling action. Contacts are self-cleaning when regularly operated; they shouldn't be filed. Seldom-used auxiliaries occasionally may need cleaning to remove sulfides



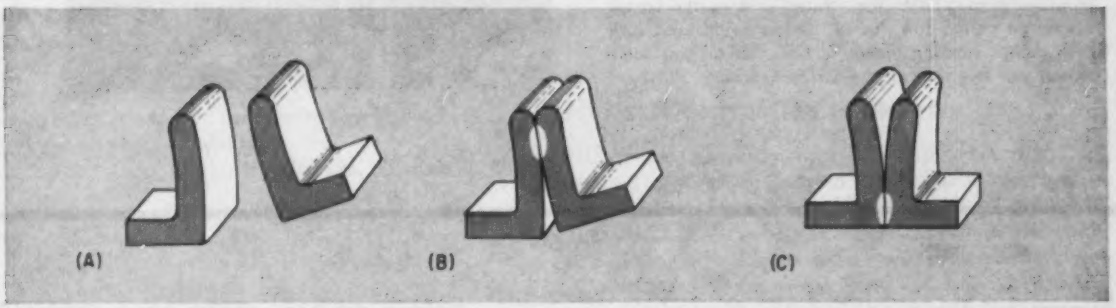
CONTACT IMPRESSION can be checked with thin pieces of tissue paper and carbon paper, with the carbon side against the tissue paper. Circuit-breaker contacts are shown; when closed and opened they leave picture of good contact *A*, or poor contact *C*



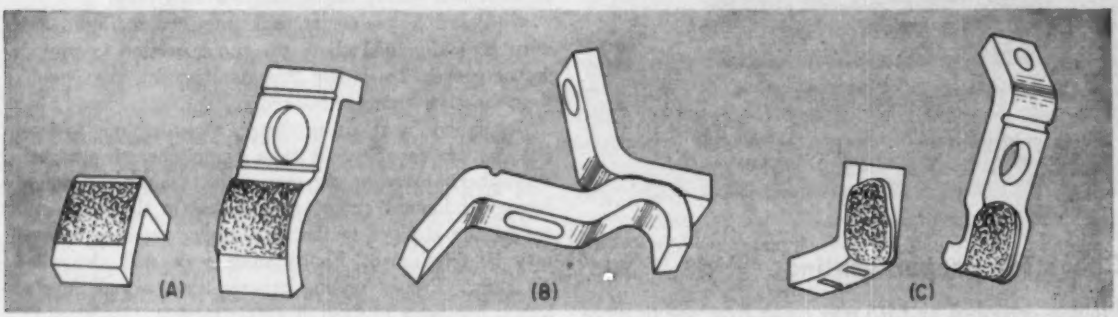
LAMINATED, or leaf, contacts are used to carry heavy load current but not make or break it. The pressure must be correct to give maximum contact as at *D*. Pattern at *E* indicates leaves need some slight scraping to get the desired contact surface



COPPER CONTACTS, often silver plated, are generally used where there is wiping action opening and closing. This keeps contact surfaces free from high-resistance film. Copper contacts which seldom open in normal operation should be operated once in a while. Common types of contacts are: *B*, combined rolling and sliding action; *C*, rolling butt; *D*, drum; *E*, sliding auxiliary. Besides wiping action, these contacts carry load current at a different point from that where contact is made and broken, below. In addition to copper and silver, copper-tungsten, silver-tungsten, carbon and metalized carbon find application. Last two aren't suitable for continuously carrying current, but they sometimes are used for heavy-duty arcing tips because carbon can't be welded by heavy currents



MOVEMENT of typical contact pairs in closing is shown in sequence *A-B-C*. Moving contact, right, changes angle as it approaches, *A*. At *B* contacts touch; some arcing and burning is liable to occur as current flow is established. In final position *C*, load current flows through area which wasn't in contact when circuit was established. Movement of each contact causes its surface to wipe or rub against the other, tending to keep surfaces clean and free from high-resistance oxide. Importance of proper contour and pressure can be seen. Check spring pressure at intervals because heat transferred from contacts may remove temper. All springs on contactor should have equal pressure. Follow manufacturer's recommendations if available, or determine values from performance



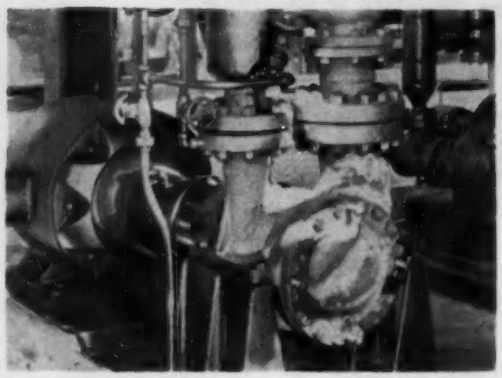
CONTOUR of contacts must be maintained. Normal wear, *A*, doesn't necessitate filing or sandpapering; contacts still fit properly, *B*. Beads or blobs of copper from abnormal arcing prevent contact over large area; file them off to restore original contour. Contact pressure must be adjusted with wear, because insufficient pressure causes overheating and oxidation. When contact's built-in *wear allowance* is used up, discard the contact. Improperly aligned contacts will burn rapidly as at *C*, and should be replaced with new ones correctly aligned

These **plant problems** could well be yours...

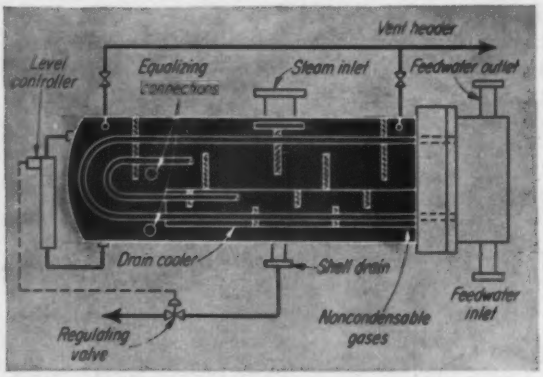
Problem...

What's wrong with our pumps?

In our 125,000-kw unit, the horizontal No. 1 l-p heater cannot be controlled. Heater has a drain-cooler section, with drains pumped to condenser by either of two full-capacity heater-drain pumps. Although we are sure that the npsh requirements of the pumps are adequately met, water level in the heater cannot be pulled down to the design point, even with both pumps running together. Can you suggest some reason for this difficulty?—*LMS, February* POWER



Solutions...



Check for proper venting

Problem described by *LMS* may result from one or more conditions. Assuming available npsh has been checked and is satisfactory, inadequate venting of the heater shell, pump casing and connecting piping may cause the trouble. Even though a feedwater heater is properly designed, some noncondensable gas will usually accumulate at the ends of a horizontal unit—see sketch at left.

A method of venting the shell is also indicated in my sketch. This arrangement has each vent discharge into a common header. Size of vents should be not less than heater-shell connections, with the header increased to accommodate total volume of all vents. A valve installed in each vent allows adjustment for balancing.

When heater has an internal drain cooler, liquid level must be maintained above the cooler section to provide submergence. To satisfy this requirement, the equalizing connections must be hooked up.

Accumulation of air in the pump casing due to leakage reduces capacity. With a pump operating at subatmospheric pressure, air may enter through the stuffing boxes. If lantern rings are installed in the boxes and condensate is piped to the rings under pressure, leakage may be eliminated. Faulty shaft seals will also allow air entry. Proper sealing between sleeves and impeller hub is necessary to keep down air intake.

If the suction piping is not tight, air will enter and collect at the top of the pump casing. Leaky flanged and screwed connections at heaters, pumps, valves and controls, as well as worn stem packing of valves and controls, are a frequent source of air entry.

...Here's how Power readers would tackle them

LAWSON STEWART, Associate Editor

Air entrained by condensate leaving the drain cooler will come out of solution because of pressure drop. Loose piping connecting the casing vents will also permit air to enter. Vents and valve-stem packing should be inspected for tightness. Installing a bleed-off valve in the vent line, with bleed returning to heater, offers a means of limiting air accumulation in the pump case.

In addition, try these five tests: (1) Compare actual system head with the design head. If system exceeds design, reduced pump capacity will result. (2) Compare heater-drain flow rate with the design value. Frequently, large turbines are capable of generating loads greatly (10 to 30%) in excess of nominal rating. This increases steam flow bled to the heater, and pump is just not capable of handling it all. (3) Inspect pump suction piping for air pockets. Long lines having improper pitch, humps or high spots allow accumulation of air. (4) Check pump wearing rings. Excessive wear allows interstage leakage, reducing capacity. (5) Inspect heater for leaky tubes. Combined condensate flow and tube leakage may exceed pump capability.

H B WAYNE, *Woodhaven, N. Y.*

Flashing condensate may be cooled or pump suction pressure raised

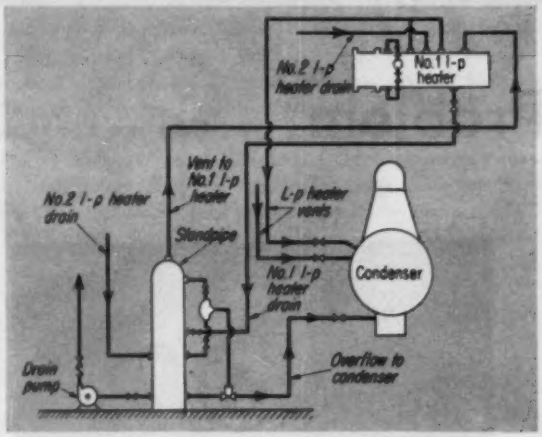
Probably the condensate is flashing in the pump suction. Most systems of this type, even with drain coolers, operate very near saturation conditions. Paradoxically, it is quite possible that the pumps have too much capacity, rather than too little. When running at normal speed, this could result in a pressure less than saturation in the suction—and your pump is "vapor bound."

If design characteristics of the drain cooler and quantity and temperature of the coolant permit, it may be possible to reduce the temperature of the discharged condensate to the pump suction by a couple of degrees —enough to lower the saturation below the suction pressure and so prevent flashing.

The other alternative is to raise the pressure at pump suction, thereby elevating the saturation temperature. This might be accomplished in either of two ways: by reducing pump speed or by increasing pump discharge pressure with a throttling valve in the pump discharge line. Temperature and pressure measurements taken on the suction side of the pump casing will, when correlated with the *Steam Tables*, indicate whether suction conditions are sufficiently close to saturation to make flashing within the pump eye a suspect.

In any case, it would be advisable to open and inspect both pumps for mechanical defects.

A R PECK, *Brooklyn, N. Y.*



Hotwell depression is answer

LMS is being troubled by a hotwell depression, the difference, in degrees, between saturation temperature at absolute heater pressure and temperature of steam condensate in heater's hotwell. Construction of the steam passages determines this difference. If ample flow area is provided between steam inlet and hotwell, pressure drop will be small. If there is a restricted flow, pressure drop will be large. When the pressure drop is large, hotwell depression is increased, which means that we have increased degrees of cooling or refrigeration effect. This cooling effect creates a vacuum which prevents the pump from pulling the water down to design level.

I suggest that *LMS* install a standpipe, as shown in sketch. Drain low-pressure heaters into it. Control the heater drains by a liquid-level control unit as indicated. Provide the standpipe with a liquid-level unit to open valve in overflow line when overflow is reached.

Standpipe should also be provided with a liquid-level control which will start the drain pump when liquid reaches the proper level. If the drain pump fails to operate and level continues to rise, overflow controller will open the valve in the overflow line and the standpipe will flow into the condenser. Standpipe also allows the water to cool a little before the drain pump picks it up. If pump fails, the level controller will dump the standpipe overflow into the condenser. Drain pump is controlled by the liquid-level controller on the side of the standpipe.

S R HIGGINS, *Long Beach, Calif.*

Want some help with plant problems? Send us any of your design and operating headaches. We'll put Power readers to work on them

More **plant problems**

Problem . . . Can we control stack emission?

Our plant operates four 30,000-lb-per-hr oil-fired packaged boilers for plant heating and process needs. Units carry two-thirds to full load most of the time. We fire No. 6 fuel oil obtained from a single source, with a desludging additive included for best pumping.

Although our combustion controls are kept in good operating condition, we constantly receive complaint notices from our municipal smoke-control inspectors. We are cited for a periodic white plume which under certain lighting conditions appears quite dense.

We have checked control settings, flue-gas analysis and everything else we could think of, while generating a plume and with a clear stack. So far we haven't been able to pinpoint anything, and are expecting to get a summons any day. We'd like to hear from readers who have had this problem and found a solution.
—*HCM, February* POWER

Solutions . . .

Remove water from fuel

HCM's problem may have two causes: (1) moisture (water) in the fuel oil (2) atmospheric conditions.

The second he can do nothing about, the first he can. Water in his storage tanks comes from two sources, condensation in the tanks and that mixed with the oil as received from his fuel supplier.

This water separates from the oil and settles to the bottom of the storage tanks, and when a new shipment is received, excess water mixes with the oil. It is then picked up by the pumps and delivered to the burner. It becomes steam in the combustion chamber, picks up minute particles of flyash and carries them out the stack with it. With the atmospheric conditions right and little or no air current, this moisture remains clustered. When combustion heat disappears from it, a plume forms.

I should state here that this water accumulates until pump picks up water and oil or all water, causing a flame failure if condition becomes too severe.

The dust and steam forms a small cloud reflecting the sunlight and casting a shadow making it appear quite dense. What is actually taking place is a meteorological phenomenon—the manufacturing of tiny thunderheads.

HCM's problem is to get rid of excess water and keep it out. He states that oil is purchased from a single source with a desludging additive added by the supplier. He should obtain a sample of this additive and run a simple test for an emulsifying agent. This can be done by adding a drop of additive to a drop of fuel oil and a drop of water on a piece of window glass or a shallow dish and observing the chemical action. The three components should quickly form a congruous emulsion (remember that this is a one-one mixture, whereas most additive suppliers recommend one quart additive to 1000 gal of fuel oil—therefore the action should be almost instantaneous).

If the present additive does not meet this test, *HCM* should purchase one that will. Additive should also maintain an alkaline condition in the tanks. Test with litmus.

HCM did not state temperature of his tanks. We have found 130 to 140 F satisfactory. At this temperature condensation does not form to such a degree that it becomes a nuisance. What condensation does form is driven off by evaporation or emulsified by the additive.

J M BASS, *Waukesha, Wis.*

Check fuel temperature, excess air

There are two causes of white smoke in oil-burning units: too much air and too hot a fuel oil. Latter trouble source is less frequent but easy to remedy. In general, fuel should be heated to a temperature about 10 F below the flash point. This value is customarily furnished by the vendor with each fuel delivery. If vendor is not presently supplying flash-point values they should be requested, since this is an essential fuel specification. If fuel is above its flash point, it will flash into vapor rather than atomize at the burner tip and a white smoke will result. Trouble from this source is quickly cured simply by reducing fuel-oil temperature.

The other, more usual, cause of white smoke is too much air. Fuel oils, being petroleum residuals, are not constant in quality even though they all come from the same source. Therefore the combustion air required can vary with each batch, depending upon the original crude oil and its subsequent history in refining. Flash point varies from batch to batch for the same reasons.

Ordinarily, in plant practice, the orsat measurement of CO_2 is considered a suitable index of combustion air. Amount of free O_2 in the stack gas is a better measurement of excess air, however, and it is therefore advisable to run a complete orsat analysis periodically.

HCM indicates that their ideal condition is a perfectly clear stack gas. This indicates too much air is being used all the time. When firing oil, optimum combustion is secured by reducing air until a very thin tan or straw-colored stack gas is obtained.

In addition to citations for smoking, this white smoke can also cause a serious maintenance problem. A hard glaze can form on the fireside under this condition and become so serious that soot blowers cannot remove it, forcing washing and perhaps even wire brushing or sandblasting.

A R PECK, *Brooklyn, N. Y.*

Where is air meeting fuel?

HCM's white plume may be caused by excess air over and above that needed for combustion, introduced right at the burner tip where the oil first enters the hot furnace and starts to break up into complex hydrocarbon conversions.

When too much air gets through the diffuser directly to the tip, instead of being spread around the entering oil spray, its cooling effect causes the hydrocarbons to stabilize in the form of a white powder which then passes through the furnace unchanged. Any air beyond the theoretical starts reducing the flame temperature, which is one reason why some excess air is required in all combustion processes. This limits furnace temperature.

The diffuser is put as close to the tip as possible, and slots are designed to permit just enough air to pass through to support combustion near the tip. If some of the slots are broken out or otherwise enlarged too much, the above effect is noted. Overall air supply may be satisfactory, and the orsat won't show a low reading, but the *proportion* of air at and around the tip is at fault. The burner manufacturer should be consulted.

H G MEISSNER, *Mt. Vernon, N. Y.*

Your May problems

Is this boiler safe?

We have been searching for a medium-sized second-hand boiler for our plant, and would like help in deciding the merits of one such unit. The boiler is about ten years old, of Stirling type H, low-head 3-drum design rated at 15,000 lb per hr of 300-psig 480-F steam.

When I inspected the boiler I discovered that tubes at the middle section of the first bank were bent sideways one-half to one in. Drum inspection indicated tubes were in good condition. Present owner states tubes were bent in erection. Insurance-company inspectors frowned on this condition but government inspector says there is no immediate danger.

We would like POWER readers to comment on probable causes of bent tubes, and suggest other tests to check the safety of this steam generator.—*SB*

How can we seal our cooling towers?

Our plant operates ten cooling towers for use in process-water cooling. We are situated in Southwestern U.S. Towers are standard steel framework with redwood lumber throughout.

Our problem stems from high maintenance on all timber. We have tried several coatings and sealers for the redwood but they blister, peel and generally lose bond in a short time.

We'd like to know whether anyone has found a reasonable solution to timber-sealant problems?—*FXM*

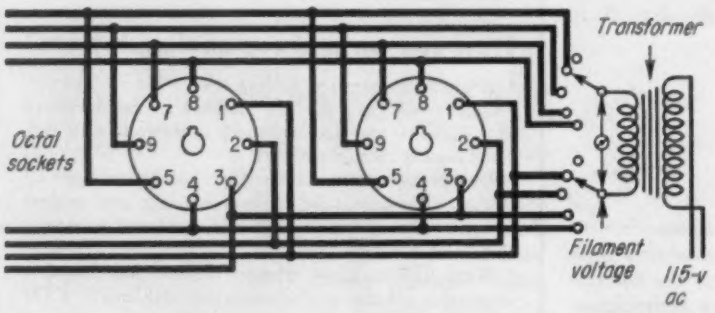
Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve

Surgeon's clamps speed electrical work

Photo shows J R Marshall using hemostats from surgeon's kit to help in his electrical work around power plants in Galveston, Texas. Marshall's son is a surgeon. When Marshall saw these castoff instruments, he tried them for holding the wires and connections in place for soldering. He soon found that it was like having three hands. Whenever he squeezes parts to their proper place, he sets clamps in the handles. Then he proceeds to tack the parts with solder.

H Hess, *Houston, Texas*



Shop-made test panel runs-in tubes before servicing

We found the first 24 hr critical for new electronic tubes used in a host of vital circuits. But we had to keep down expense of maintaining the transmitter-receiver units used on heavy-duty mountain coal-hauling rigs. How? We fixed up the shop panel to run- or burn-in filaments of new tubes before they're installed in trucks and supervisors' cars.

My sketch shows two tube sockets, but any reasonable number can be used. Voltage is fed to the tubes through the selector switch energized by an instrument type stepdown transformer. Under these conditions only one type of tube may be run-in at a time.

P C Ziemke, *Clinton, Tenn.*

No tickee, no shirtee . . .

An ice-cream firm had specifications prepared to cover plant improvements. But the management assumed responsibility for inspection as the work progressed. They didn't want to pay the cost of an engineer to keep an eye on the project.

Specs called for the liquid-ammonia receiver to be fitted with a safety relief valve and a ½-in. valved opening in top of the shell for future connection of an automatic air purger. Specs also called for a 10-ft length of flexible ammonia-charging connection. But neither valves nor charging connection were furnished by the contractor.

Two ammonia suction pressure-regulating valves were also specified. These were to have a completely valved full-sized bypass to permit operation in case regulating valves had to be repaired. But bypasses were not furnished either.

Thermometers were specified for indicating temperature of water entering and leaving the ammonia condenser and water section of the tubular milk cooler. They weren't put in.

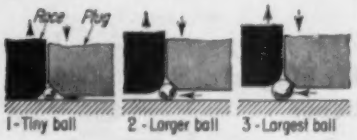
Also indicated were hand purge valve and a liquid pump-out valve for condenser. Neither was put in.

Question: Why was the contractor allowed to get by with this sort of swindle? Answer is that unless you pay for trained men who know what they are doing to look after your plant, you can expect to be rooked. It's the old story—no tickee, no shirtee.

C T Baker, *Atlanta, Ga.*

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

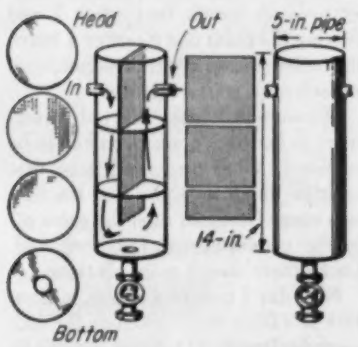


Plug and steel balls do it!

We had the problem of removing a ball bearing from a blind housing. Job was done by dropping a number of small-diameter balls into the blind hole so they settled around the inner race, sketch. We spread balls around ID of the race and held them in place with grease.

Then we forced them under the radius of the bearing with a chamfered plug as shown. By removing plug and small balls and substituting larger ones, we were able to get a pry under the bearing, forcing it up.

H KOSLOW, *Bronx, N. Y.*



Handy moisture traps keep compressed-air system dry

To keep moisture out of our compressed-air system and give our maintenance boys something to do during slack periods we made up a large number of moisture traps. Body of trap is a 5-in.-dia pipe, 14-in. long. Baffles on the inside are made of ¼-in. sheet iron, sketch. Vertical and horizontal baffles are welded in after being cut to close fit. The first few traps worked so well we installed them throughout our system.

T MULLIN, *Seattle, Wash.*

What would you have done?

Last time we overhauled our steam turbine a 2½-in. socket wrench fell down a 16-in.-ID steam line. Wrench fell eight ft, passed around the elbow, then came to rest about a dozen or so ft away from it. Our big problem was getting a hook of some kind around that bend without shoving the wrench farther along.

We spent a couple of days trying to fish it out, but no soap. Then our foreman, Al Brandsema, dreamed up a jet-propelled grappling hook. This he made by connecting a ¾-in. air hose to a ½-in. tee fitting. He screwed two short pieces of ½-in.-OD copper tubing into the tee, bent the jet ends in the direction of the hose. Hook formed by the copper tubing measured 10-in. across the flukes.

This grappling hook was lowered into the 16-in. steam line, and 100-psi air turned on. Jet action carried the hook past the socket wrench. We turned off the air. On pulling our hook out of the line we found the wrench attached to a fluke—on the first try! And to think we wasted two whole days! What would *you* have done?

M MARSHALL, *Island Park, N. Y.*

Want to slash air-compressor maintenance time?

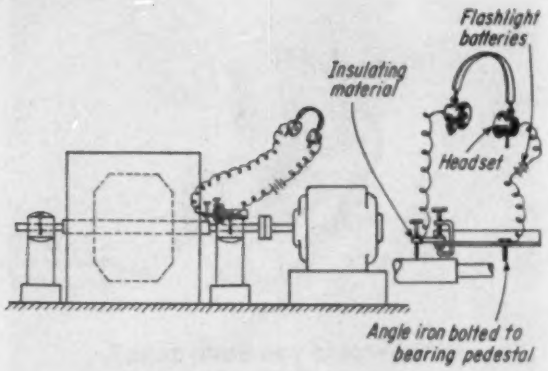
Each shutdown of a compressor for cleaning is expensive. For example, when a 4-stage compressor on a 100-cu-meter column in an oxygen plant is out of service for cleaning, it takes 20 hr of downtime and 32 manhours of labor to remove valves, clean them and clean the discharge chambers. Labor comes to about $128, and every time this is done 70,000 cu ft of oxygen and $350 in sales are lost. In a well-run oxygen plant a compressor normally has to be cleaned twice a year. So any way you can extend this time means additional profit for your operation.

One way to save downtime is to use fire-resistant compressor lube oils. Field tests show that besides fire resistance, these oils give an unexpected benefit over petroleum oils: they form relatively little deposit on valves and in discharge lines. Clean valves are tight valves and maintain efficient compressors. Recompression and high discharge temperatures are avoided.

—*Courtesy, Mobil Oil Co, Inc*

Can you use $15?

Send me your *Biggest boner*, or a candidate for *What would* you *have done?*—do it now!—STEVE ELONKA



We made our own fan balancer; now vibration is low

Sketch shows how we made a balancer for our forced- and induced-draft fans. This method of balancing rotating equipment isn't new, but marking the shaft is the most sensitive indication I've seen.

Marker has a ¼-in. rod pointed and threaded with National Fine Threads. This rod is screwed into a piece of insulating fiber ¾-in. thick. Fiber is drilled and tapped to receive the rod. Then it's fastened to the angle iron with a "C" clamp.

One wire is attached to a clip that's bolted to the fiber so that it touches the marking rod at all times. Other wire is attached to the bearing pedestal. When rod's point touches the shaft, circuit is complete and a click is heard in the headset, caused by making or breaking the circuit.

We painted shaft on both sides of fan with Prussian blue. Then we set up the equipment and ran fan at full speed. Marker was screwed down until clicking noise was heard. Fan was then shut down and the heavy side determined from mark on the shaft. We tested the fan on both shaft ends; both indicated that same side was heavy.

We attach balancing weights to the light side of our fans until a light mark runs practically all the way around the shaft. This is point where vibration is reduced to our satisfaction and everything is shipshape.

E W McKnight, *Chapel Hill, N. C.*

Iron cement pinch-hits on maintenance and repair jobs

Iron cement is useful as a space filler, a grouting material, to improve the appearance of castings, and for many other foundry and maintenance jobs. A steel company uses iron cement to improve the appearance of castings instead of more-expensive welding and brazing. Company finds that where porosity and cavities are not bad, iron cement gives a better appearance than welding — the finish matches the casting itself. Material can also be ground to produce desired contours. For plumbing fixtures, iron cements are used as dead filler material to eliminate pinholes in castings. They look smooth and attractive.

—*Courtesy, Smooth-On Mfg Co*

My biggest boner

I worked in a plant having a fully automatic, packaged type firetube boiler. Because unit also had an automatic feedwater regulator, operators got so they'd push the starting button, then let the boiler fire and feed itself while they fluffed off to more pleasurable things in the locker room.

One day the button was pushed, starting her cycle. But as she came to the point where fuel-oil ignition should have taken place, the relay kicked out. Operator then discovered that if he held the relay in at that point, she would ignite.

Instead of notifying his chief, the operator kept right on starting up by holding the relay switch until the boiler fired. A month later when I was leaving the plant one morning I heard the boiler start to cycle, then quit, start up and quit, start—then Boom!

We were very lucky that only brickwork in her back connection had to be replaced. What happened was that ignition didn't take place on the first two tries. The third time the extra oil in the combustion chamber ignited. Lucky there wasn't more oil there.

Next day I noticed these rules from Power's *Data sheet* tacked on the wall —**underlined:** (1) Never attempt to light a burner without venting the furnace until clear. Burns are painful. (2) Always assume delayed ignition is going to cause furnace explosion. Use proper ignition methods. (3) Always allow draft to clear furnace of gas and dust for several minutes. Change draft conditions slowly. (4) Never fail to report unusual behavior of a boiler or other equipment. It may be a warning of danger. I was happy to see this step taken. But here's a question I'd like to have answered: Why are rules usually heeded *after* an accident rather than before?

J K Neal, *Cuyahoga Falls, Ohio*

Picking mechanical seals for slurry service?

By ROBERT FORNESI
Goulds Pumps, Inc

Single or double? Internal or external? Before answering learn how slurry reacts with seal parts

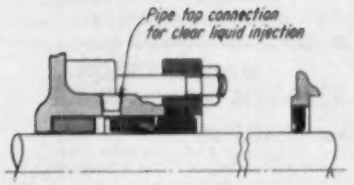
Pinning down whether solids in the slurry to be pumped are shapeless (amorphous) or crystalline is really the first step in mechanical-seal selection. Reason: Amorphous solids are usually not abrasive while crystalline solids in general are hard and can destroy seal faces.

Amorphous solids are usually found with organic chemicals, and a single seal can frequently be used. However, they may tend to gum up the seal springs and prevent them from holding the seal faces together. Failure results. Single seal mounted outside is often a satisfactory solution—here springs are not exposed to the slurry and there's no interference with their proper function.

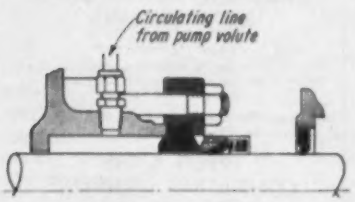
Crystalline solids usually tend to destroy seal faces unless properly excluded. Size of crystalline particles, pressure behind them and viscosity of the liquid govern how easily they work in between the seal faces. Viscosity, or film thickness, determines operating distance between faces. With very viscous liquids the seal faces run further apart and larger particles can enter.

Where clear liquid can be injected at a pressure slightly above that of stuffing box a single seal may be OK. Flow in seal chamber is away from the faces, carrying out any solids that have entered. Pumpage dilution can be minimized by carefully controlling injection pressure and using a close-running throat bushing to throttle the diluting flow. Of course, if system remains pressurized when not actually operating, injection flow must also be left on to keep crystals out of the seal chamber.

In all cases, construction materials must be selected carefully to minimize corrosive and erosive effects of the slurry and the injection liquid where used.



Single internal seal



Single external seal

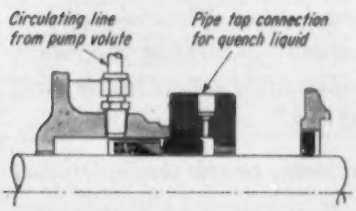
Double seal

Double seals need clear injection

A double seal is really two single seals back to back. Slurry is excluded from the seal chamber and an outside source of clear liquid is provided to lubricate and cool seal faces from within. Clear liquid must be supplied at a pressure about 20 psig above maximum pressure on inboard seal. This assures seal-face contact under all conditions and provides a small flow through the inboard seal to exclude solids.

Quenching gland prevents crystallization

A quenching gland should be used with a single seal when pumpage crystallizes on contact with air or at reduced temperatures. Abrasive crystals formed must be flushed away before they can re-enter the seal faces and accelerate wear. Quenching-flow and pumping-liquid temperature should be about the same, so seal faces won't cool and cause precrystallization. Flexible quench lines (inlet and drain) can be used to avoid straining the gland. If gland runs in close clearance with the shaft, quenching liquid is contained in the gland and not allowed to spray out. Alternately, a few rings of packing in the gland prevent escape of quenching liquids.



Seal with quenching gland

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For the solution of your problems, consult the Professional Services Section of Power.

SEARCHLIGHT SECTION

Classified Advertising

EMPLOYMENT BUSINESS **"OPPORTUNITIES"** EQUIPMENT USED OR RESALE

DISPLAYED —RATES— UNDISPLAYED
The advertising rate is $20.50 per inch for Equipment & Business Opportunity advertising appearing on other than a contract basis. Contract rates quoted on request.
Employment Opportunities—$17.40 per inch, subject to Agency commission.
An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.
$2.10 per line, minimum 3 lines. To figure advance payment count 5 average words as a line. Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Positions Wanted undisplayed advertising rate is one-half of above rate payable in advance.
Box Numbers—count as one line.

POWER PIPING SALES

Major Texas pipe fabricator and erector offers excellent opportunity for aggressive sales representative having established contacts with Consulting Engineering firms and Electric Utility companies. Should live in New York or Chicago area, though not necessary. Important that he be energetic, experienced producer in Power Piping field. Salary commensurate with experience and ability. Submit complete resume and salary desired.

RW-3958, POWER
520 No. Michigan Ave., Chicago 11, Ill.

STATIONARY ENGINEER

Recent college graduate to assist in operation of a large industrial plant power station.

Responsibilities will include steam, refrigeration, compressed air, vacuum, and other auxiliary services.

Send detailed resume to

P-4160, POWER
520 N. Michigan Ave., Chicago 11, Ill.

ADDRESS BOX NO. REPLIES TO:
Box No. Classified Adv. Div. of this publication.
Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITIONS VACANT

Wanted — Electrical Engineers. Minimum five years experience in Public Utility Distribution, Transmission, Metering and Relaying. Required for permanent, responsible positions in Venezuela. Spanish an asset but not essential. Good living conditions. Starting salary of $13,000 per annum. P-3548, Power.

Position open for Mechanical Sales Engineer for Boiler Sales and Engineering—College Graduate, Under 35, Military Training Completed. Location—New York City Trading Area. Previous experience desirable but not a must. Salary dependent of applicants qualifications. Send complete resume of education and experience to P-3557, Power.

Mechanical Engineers. Excellent opportunity for Project Managers, Project Engineers, and Design Section Chiefs experienced in design of heating, ventilating, air conditioning, piping, power plants. Extremely wide variety of work (including client contact) with established Midwest consulting firm. Permanent. Good starting salary, advancement and vacation program. Moving expenses paid. All replies will be answered. P-3214, Power.

Design (Mechanical) Engineer with experience in design of boiler plants, coal and ash handling systems, economic studies for industrial and utility plants. Must be able to write clearly and concisely. Location East. Send complete resume including salary requirements to P-4006,

POSITIONS VACANT

Wanted a steam engineer to act as relief turbine operator and head fireman. We have 9,500 KW generating capacity Steam pressure 450#. P-3781, Power.

SELLING OPPORTUNITY AVAILABLE

Manufacturers agents wanted by leading manufacturer of Pipe Alignment Guides. Prefer agents handling Expansion Joints or similar pipe specialties. RW-4206, Power.

POSITIONS WANTED

Power Plant Engineer, age 38, technical education, 8 yrs. experience as chief engr. in the operation, maintenance, management, and plant betterment. PW-3449, Power.

Power Engineer—Graduate E.E. Swiss Fed. Inst. Technology, 32 years, single. Nine years exp.: utilities, mining, chemicals: diesel-, steam-, hydro-electric plants, industrial engineering, electrical distribution and transmission: engineering, field work, operation, maintenance, technical correspondence. Fluent English, Spanish, French, German. Present location South America. Future location open, USA or abroad. Available soon for interview USA. PW-4129, Power.

WE PAY
$ CASH $
FOR
Electric Motors • Starters • Transformers
Circuit Breakers — Electric Supplies
ALLIED ELECTRIC CO.
710 N. MAIN ST., MEMPHIS, TENN.
BOX 1088 — PHONE JA 7-1681

Circle 507 on Reader Service Card

WANTED

FAIRBANKS-MORSE 32E14 200-300 KW 2400 V 3 phase 60 cycle Generating Set with switch gear & auxiliaries.

COMMUNITY UTILITIES INC.
Dept. TOK, Box 1, Quincee, Washington

Circle 500 on Reader Service Card

GET CASH NOW
for your new surplus motors, controls and transformers!
AVAILABLE: NEW MOTORS
Write, wire or phone
AJAX ELECTRIC MOTOR CORP.

Circle 501 on Reader Service Card

WANT MORE MONEY WANT BETTER JOB GET 2nd CLASS ENGINEER Lic. IN 1 YR.

ATTENTION TO:

3rd Class, Asst. Engineers, Firemen, Oilers, Wipers Laborers

Apply for monthly Boiler Room 100 Question & Answer Bulletins. Make us prove these statements.

For information write:
A. E. KARPF
88 Ashwood Dr. Rochester 9, N. Y.

Circle 502 on Reader Service Card

MUST BE SOLD IMMEDIATELY

No reasonable offer refused

We are dismantling one of the largest textile mills on the East coast. All equipment offered is in place and in operating condition. Listed is some of the equipment:

- Richardson coal scale model h 39, 500 lb. cap.
- 200 ft. bucket conveyor complete, bucket size 9" x 16" x 20"
- United ash conveyor with ash intake, conveyor pipe, ash receiver, exhauster, air washer & 2,200 cu. ft. hopper with dustless unloader
- Cochrane hot process softener, 10,000 gal. cap.
- Boiler 110,000 P.S.HR. 675 lb.
- Steam generators 2,500 KW, 2,300 volt.
- Pumps oil & water
- Oil & water meters up to 4"
- Used boiler tubes
- Plus many other items

COREY BLDG., WRECKING
LOWELL, MASSACHUSETTS
GLENVIEW 2-8908

Circle 503 on Reader Service Card

MODERN POWER BOILERS

1—Babcock & Wilcox	—200,000#—	625 psi
1—Combustion-Engineering	—110,000#—	675 psi
1—Babcock & Wilcox	— 90,000#—	600 psi
2—Babcock & Wilcox	— 85,000#—	250 psi
1—Combustion-Engineering	— 75,000#—	775 psi
1—Combustion-Engineering	— 60,000#—	250 psi
1—Riley	— 60,000#—	200 psi
3—Combustion-Engineering	— 50,000#—	250 psi
3—Combustion-Engineering	— 50,000#—	291 psi
1—Babcock & Wilcox	— 45,000#—	400 psi
2—Union Iron Works	— 40,000#—	250 psi
2—Babcock & Wilcox	— 30,000#—	250 psi
1—Babcock & Wilcox	— 27,500#—	300 psi
2—Babcock & Wilcox	— 15,000#—	250 psi

Dismantling and re-erection under one responsibility

MIDWEST BOILER & TURBINE CO.
Warner, New Hampshire

Circle 504 on Reader Service Card

DIESEL ENGINES FOR SALE

FAIRBANKS MORSE DIESEL ENGINES, Model 7-38E5¼, 450 BHP @ 1200 RPM. Made to rigid Navy Specs. In excellent operating condition. Navy Acq. cost $38,200.00. Write for special price. Inspection invited.

SALMINI MARINE COMPANY
888 River Road, Edgewater, N.J. Whitney 8-1312

Circle 505 on Reader Service Card

BOILERS

FOR SALE, SPECIALLY
BABCOCK & WILCOX
SECTIONAL HEADER

ARG CHEMICAL MACHINERY
507 Fifth Avenue, New York 17, N. Y.

Circle 506 on Reader Service Card

FROM AIRCRAFT CARRIER
"ENTERPRISE"

[4] 1000 KW
GEARED
TURBO-GENERATORS

For Condensing
or Non-Condensing

1000 KW TURBO-GENERATOR
COMPLETE WITH CONDENSERS
CIRCULATING PUMPS
CONDENSATE PUMPS
AND SWITCH GEAR

GENERATOR: 1000 KW — type ATB-2 — G.E. — form H.L.—1250 KVA—3/60/450—1605 amps—3600 RPM—0.8 P.F.—field amps 87—typical serial No. 5358205—with 120 volt 17KW DC exciter—compound wound.

STEAM TURBINE: 1000 KW G.E.—type FSN-4R-FN30-85TG—rated 7964 RPM—exhaust 1 lb. absolute when condensing.

REDUCTION GEAR: S-119—form A—RPM 7964/3000.

TURBINE STEAM PRESSURE: 375 lbs—175°F superheat—exhaust pressure 1 lb. absolute when condensing. Can be used condensing or non-condensing.

BUILT AS MARINE UNITS USING FINEST MATERIALS. DRIP - PROOF CONSTRUCTION. UNITS ARE 16' LONG — 7'8½" WIDE. MOUNTED ON PRE-FAB SUB-BASE.

OPERATING CONDITIONS

1. The turbines are designed for normal operation condensing at 375 lb per sq in gauge, 175°F superheat steam at throttle, and 1 lb. per sq. in. absolute at the turbine exhaust flange
2. The turbines will operate successfully condensing at 375 lb. per sq. in gauge, 0°F superheat at throttle, and 1 lb. per sq. in. absolute back pressure at the turbine exhaust flange.
3. The units have an overload capacity of 25% (1250 KW, 0.80 p-f) for two hours with normal main and exhaust pressures.
4. The units have an overload capacity of 50% (1500 KW, 0.80 p-f) for five minutes with normal main and exhaust pressures.
5. The units will deliver normal output (1000 KW, 0.80 p-f) with main pressure 20% below normal and with a back pressure of 2 lb. per sq. in. absolute at the turbine exhaust flange.
6. The turbines will operate successfully with a maximum main pressure at 430 lb. per sq. in. gauge and with a maximum superheat of 200°F at the throttle.
7. The turbines will develop 500 KW with 375 lb. per sq. in. gauge, 175°F superheat steam at throttle, and 29 lb. per sq. in. gauge back pressure at the turbine exhaust gauge.
8. The turbines will operate successfully when extracting steam from the second-stage shell of the turbine. An automatic pressure regulating valve and a non-return valve should be installed in the extraction line to hold the extraction steam at approximately 10 lb. gauge and to prevent a return flow of steam to the turbine.
9. The turbines will operate successfully with full steam flow to atmosphere.
10. The units will cover the entire range of conditions as listed above under automatic control of the speed governor.
11. The steam flow to the throttle is guaranteed not to exceed the amounts listed in Part V for the given loads when operating with steam at 375 lb per sq. in. gauge at throttle, 175°F superheat, and 1 lb. per sq. in. absolute at the turbine exhaust flange. The guaranteed steam flows include the necessary steam for sealing the packing glands, and includes the electrical losses for the exciter fields and rheostats.

THE BOSTON METALS CO.

313 E. Baltimore St. Baltimore 2, Md.
ELGIN 5-5050 LEXINGTON 9-1900

Circle 508 on Reader Service Card

POWER EQUIPMENT DIVISION

BOILERS

3—1296 HP B&W Sect. Steel Header 275 PSI Gas/Oil Fired
2—200 HP 160 PSI Keeler, Stoker Fired
12—NEW UNASSEMBLED B&W, F.W. C.E. with Superheater, Economizer, Soot Blowers, Oil Burners, Steel Encased—Rated:
122,500#/hr, 565 PSI, 850°F
44,500#/hr, 450 PSI, 735°F
35,000#/hr, 285 PSI, 577°F

A. C. MOTORS — 3 ph. 60 Cy.

Qu.	HP	Make	Type		Speed	Volt
1	350	A.C.	AZZ	TEFC X.P.	3600	2300
1	250	Cont.	NP	TEFC X.P.	720	2300
1	200	G.E.	KF	TEFC X.P.	3600	2300
1	125	G.E.	KF	TEFC X.P.	1800	2300
3	100	G.E.	K	TEFC X.P.	1800	440
1	150	West.	CW	Slip Ring	1800	440
3	75	West.	CW	Slip Ring	1800	440
3	30	West.	CW	Slip Ring	1200	440

GENERATOR SETS

11—1250 KVA Natural Gas Engine Sets 3/60/2400/4160 with switch gear
(can be seen running)
1—500 KW Condensing 200 PSI Turbine
1—500 KW G.E. Non Cond. 265 PSI, 0-10# BP Turbo Generator

TRANSFORMERS

1—6000 KVA 3/60/44,000—4160 Substa.
3—500 KVA 1/60/66,000-480
3—333 KVA 1/60/2400/4160 Y—480

CRANES

40/10 ton OET 47'3" Span 75' Lift AC
25 ton Powerhouse 36'6" Span AC

HEAT & POWER CO. INC.
60 East 42nd St., New York 17, N.Y.
310 Thompson Bldg., Tulsa 3, Okla.

Circle 509 on Reader Service Card

SLIP RING MOTORS—3 ph. 60 cy.

Qu.	HP	Make	Type	Volts	Speed
1 new	3500	G.E.	MT-39	4160/6600	240
1	2200	Al.-Ch.		2300	300
1	1800	West.	HF1227	2300	353
1	1000	G.E.	M-9758	2300	1200
1	500	Al.-Ch.		2300	393
1	450	West.	CW	2300	594
1	300	West.	CW-955C	2300	1150

SYNCHRONOUS MOTORS—3 ph. 60 cy.

2	5000	Al.-Ch.		13800/6900	514
1	4200	West.	80%	4160	300
1	4000	West.		11000	300
1 new	4000	West.		4160/2300	1200
2	1700	G.E.	TS	4160/2300	720
1	1500	West.		2300	514
8	1250	El. Prd.		2300	1200
1 new	920	G.E.		2400/440/220	300
3	700	West.		2300	1200
1	500	West.		2300	1800
1	450	West.		2300	1201½

SQUIRREL CAGE MOTORS—3 ph. 60 cy.

2	2000	Ideal	M-8	4160	900
1	800	West.	CS	2300	580
1	800	West.	CS-44	4000/2300/440	1787
1	600	West.	CS	440	3570
1	600	G.E.	K-63306	440	3570

TRANSFORMERS—60 cycle

Qu.	KVA	Make	Type	Ph	Voltage
1	3000	G.E.		3	23,500x480
1	2000	G.E.	OA-T	3	26,400x2400
1	1750	Penna.	OISC	3	2200x220
1	1500	West.	dry	3	4160x2400
6	1500	West.	SL	1	24,000x480
1	900	Wagner		3	2300x230/440
3	833	Penna.	OISC	1	23000x2300

M-G SETS—3 ph. 60 cy.

Qu.	KW	Make	RPM	D.C. Volts	A.C. Volts
2	3500	Al.-Ch.	514	250/700	13800/6900/4160
2	1900	G.E.	720	250	2300/4160
1	1000	West.	720	250	2400
1	400	West.	1200	250	2300
2	300	G.E.	1200	250	2300

INDUCTION HEATING UNITS

1—500 kva. West. 5000 cycles 500 volts water cooled
1—1250 kva West. 960 cy. 500/2500 v. water cooled.

DUQUESNE ELECTRIC & MFG. CO.
6413 Hamilton Ave., Pittsburgh 6, Pa.
Tel. Montrose 1-5000
Write for new catalog.

Circle 510 on Reader Service Card

ELECTRICAL POWER EQUIPMENT

SLIP RING MOTORS

3 ph 60 cy 220 or 440 volts

HP	RPM	MAKE	TYPE
1500	514*	Al.-Ch.	Mill Type
1200	360*	Al.-Ch.	Mill Type
900	180*	Al.-Ch.	Mill Type
600	1800*	Gen. Elec.	M-63458, Dppf. New
500	1200	Gen. Elec.	M-63455, Dppf.
400	720	Gen. Elec.	MT-3787
350	900*	West.	CW
350	1800*	Al.-Ch.	ARYW (2)

*2200 volts or higher

SQUIRREL CAGE MOTORS

3 ph. 60 cy. 220 or 440 volts
(*2200 volts or higher)

HP	RPM	MAKE	TYPE
1250	3600*	Al.-Ch.	ANX
800	1800	West.	CS24C
600	600*	West.	CS-44-C15 Dppf (2)
500	1200	G.E.	I-K
400	1800*	L. Allis	BB, Dppf.
400	1800	West.	BB, Dppf.
400	1200	G.E.	KTP-565
350	3600	Cr.-Wh.	SC, Dppf.
300	1200	G.E.	KT-559, Dppf.
300	600*	West.	CS-30A
300	600*	West.	CS-1092

MOTOR GENERATOR SETS

KW	Make	Motor A.C.V.	Generator D.C.V.
1000	West.	4160	250
600	G.E. (3 unit)	2300/440syn.	125/250
500	West.	2300/440syn.	125/250
400	Al.-Ch.	2300/440syn.	125/250
300	West.	2300/480syn.	250
300	Rel.	2300/440syn. TS	500
300	G.E.	2300/440syn. TS	250/275
200	Ridgwy	2300syn.	250
150	Al.-Ch.	220/440/220	250
130	West.	2300/440/220syn.	125/250
125	West.	2300/480syn.	250
125	G.E.	2300/480syn.	250
100	West.	2300/4000syn.	250/275

TRANSFORMERS

Special Offer — Like New

3—1250 KVA Allis Chalmers Class OA Oil filled 3ø1 ph 60 cy 24,000 Volt primary, 480 volt secondary with taps, manufactured 1955.

Write for current complete stock lists on electrical power equipment you need or send your list of surplus and used equipment for our offer.

Phone CAnal 6-2900

CHICAGO Electric Co.

1320 W. CERMAK ROAD • CHICAGO 8, ILL

Circle 511 on Reader Service Card

TRANSFORMERS

2—16,667 KVA General Electric unused 3 phase, 60 cycle primary voltages—88000/77000/44000/38500/22000 secondary voltages—11500/6600/5700/4300 taps—2 above and 4 below rated voltages.

3—1667 KVA Allis Chalmers 1 phase, 60 cycle outdoor 7200/12,470 volts primary, 2400 volts secondary.

3—1000 KVA Kuhlman 3 phase, 60 cycle, outdoor 13,800 volts primary, 380 volts secondary.

1—1000 KVA General Electric 3 phase, 60 cycle auto-transformer, 2400/4160 volts primary, 2400/4160 volts secondary.

1—750 KVA Westinghouse 3 phase, 60 cycle outdoor 33,000 volts primary, 120/208 volts secondary.

3—333 KVA Westinghouse 1 phase, 60 cycle indoor 13,000 volts primary, 240/480 volts secondary.

3—250 KVA Allis Chalmers 1 phase, 60 cycle outdoor 11,500 volts primary, 480 volts secondary.

5—200 KVA General Electric 1 phase, 60 cycle, outdoor 13,200 volts primary, 2400/4160y volts secondary.

3—50 KVA Westinghouse 1 phase, 60 cycle outdoor 600 volts primary, 120/240 volts secondary.

L. J. LAND, INC.

Box 689, Weehawken, N.J. UN 4-1010
Box 756, Reading, Pa. FR 5-8474

Circle 512 on Reader Service Card

AUTOMATIC and MANUAL
Gas or DIESEL GENERATOR UNITS
Complete Switchboard Design and Construction
USED & REBUILT EQUIPMENT
UNIVERSAL POWER ENGINEERING CO.
382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

Circle 513 on Reader Service Card

COMPLETE MODERN 400 LB. POWER PLANT

3750 KVA Elliott Turbine Generator—563 H.P. Wickes Boiler 475 PSIG W.P.

Turbine is 440 PSIG 750° FTT Generator is 3/60/2400/4160. Surface Condenser and all auxiliaries.

This plant is complete in all respects and can be inspected as originally installed. Photographs, prints and specifications available

Other turbine Generators

1-1500 KW Westinghouse	600≠ 750° Non-Cond. 150≠ BP 2400V
1-2000 KW GE	600≠ 750° Non-Cond. 150≠ BP 4160V/6600V
2-3000 KW GE	600≠ 750° Non-Cond. 150≠ BP 2400/4160V
1-2500 KW Allis Chalmers	400≠ Autext 150° Non-Cond. 30≠ 480V
1-2500 KW Westinghouse	125≠ Non-Cond. 10≠ BP 2300V
1-2500 KW GE	400≠ 750° Autext 25≠ Condensing 600V

Cable Address: CHASWEAVER

CHARLES WEAVER, INC.

19701 JAMES COUZENS HIGHWAY
DETROIT 35, MICHIGAN

Telephone: BRoadway 3-1900

Circle 514 on Reader Service Card

DIESEL ENGINE GENERATOR SETS

Immediate Delivery from Inventory!

Any voltage; 50 or 60 cycle. Available in stationary, mobile or portable model. Following listing is only partial.

2000 kva Fairbanks-Morse model 33F16 (photo above)
1420 kva Fairbanks-Morse model 38D—8⅛
1375 kva General Motors model 278A
1250 kva General Motors model 567
938 kva General Motors model 567
625 kva General Motors model 278A
625 kva American Locomotive Co. model 539
412 kva Worthington model CC
375 kva General Motors model 268A
312 kva General Motors model 268A
250 kva General Motors model 268A

A. G. SCHOONMAKER Company, Inc.

Foot of Spring St., Sausalito, Cal. Edgewater 2-1490
50 Church St., New York 7, N. Y. Digby 9-4351

Circle 515 on Reader Service Card

UNUSED—ASSEMBLED—NEW

IN ORIGINAL MANUFACTURER'S PACKING CRATES

BOILERS (Package type)

B&W—60,000 lbs./hr.—475 psig., 740°TTF, oil fired (shipped intact as one integral unit)
B&W—122,500 lbs./hr.—635 psig., 850°TTF, oil fired (unassembled)

TURBOGENERATORS

4600 KW GE Turbine—Gen Set, Cond 410psi, 725°TTF, 28.5 Hg exh, 3/93.3/2700V PF 1.0—New
1800 KW GE Turbine—Gen Set, Cond 410psi, 725°TTF, 28.5 Hg exh, 3/60/1735 V PF 0.8—New
1000 KW GE Turbine—Gen Set, Cond 200psi, 600°TTF, 28.5 Hg exh, 3/60/2400V PF 0.8

STEAM TURBINES

1000 SHP GE Cruising Cross Compound, 525psi, 825°TTF, 81psi exh, 10,119/350 RPM with Falk reduction gears—New
3000 SHP GE HP Main propulsion turbine 410psi, 9040RPM, 725°TTF; 3000 SHP GE—LP Main propulsion turbine 40psi, 9040RPM } 1 Set—New
11,550 SHP GE HP 12 Stage Cross compound turbine 525 psig, 825°TTF 5870RPM; 13,450 SHP GE LP 48psig, 4714RPM with Westgh speed decreaser gear assy. } 1 Set—New
394 HP Worthington-Moore, Non-Cond, Form #S2R, 310psig, 650°TTF, 2psi-exh, 3560RPM

PUMPS, CENTRIFUGAL (Motor driven)

263 GPM @ 375'TDH, Ingersoll Rand—2GT, w/60HP 3525RPM 3/60/220/440V (Used)
275 GPM @ 635'TDH, Ingersoll Rand—2GT, w/75HP 3525RPM 2/60/2300V (Used)
200 GPM @ 1300'TDH, Ingersoll Rand—½CNTA, w/Base, Motor optional

PUMPS, CENTRIFUGAL (Turbine driven)

460 GPM @ 750psi discharge, Worthington, w/350HP turbine, 575psi, 4900RPM—New

BLOWERS, TURBO-CENTRIFUGAL

20,000 CFM @ 17"WC, Westinghouse, Vaneaxial, w/Turbine, 82.5HP, 375psi, 10psi—exh, 4625RPM—New
24,000 CFM @ 28"WC, Sturtevant Co, Rexvane, w/Turbine, 191HP, 400 psi, 10psi—exh, 3525RPM—New
43,000/50,000 CFM @ 8"/11"WC, Sturtevant, Turbovane, w/Turbine 86/141HP, 400psi, 10psi—exh, 4980/5870RPM—New

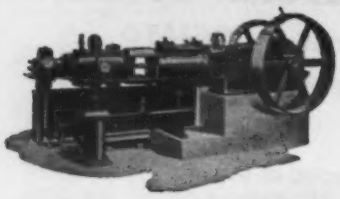
WABASH POWER EQUIPMENT CO.

9750 SKOKIE BLVD., CHICAGO (Skokie), ILLINOIS

TEL. OR. 3-8118

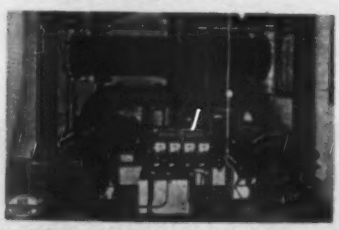
Circle 516 on Reader Service Card

THE COMPRESSOR LINE

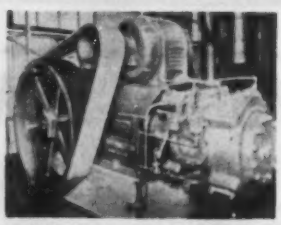


HIGH PRESSURES

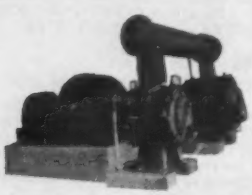
26.8 CFM 3000 psi Worth. V4A3
97 CFM 1500 psi 6½—9½—11½ x 7 CP TCB 3
113 CFM 2900 psi 6½—4½—1-11/16x9 IR ES3
119 CFM 5000 PSI Worth. V3A6
150 CFM 3000 psi 13½x12 Norwalk TRS4T
311 CFM 1500 psi 16½—7½—9½ x 13 IR ES3
351 CFM 350 psi 11-3x11 CP-TCB-2



2308 CFM 50 PSI 10-10x14 Pennsylvania DE-1 direct connected 300 HP Synchronous 3/60/2300 volts, M-G set and controls. Excellent.



Unused 9x9 Worthington HB with unused accessories complete—40 HP motor, starter, 24"x6' ASME Air Receiver, Aftercooler, Separator over-head M-U-Drive, belt guard, and filter. SPECIAL $3875.00.



3864 CFM Displacement, 90-125 PSI, 164 RPM, 700 H.P. Motor. New 1941. 33/20 x 24 Worthington DC-2, two stage water cooled, heavy duty, horizontal, Synchronous motor driven air compressor equipped with: Five step control; intercooler; mechanical lubricator. DIRECT CONNECTED TO: 700 H.P. General Electric type TS 164 RPM 2/60/440 volt engine type motor with MG set, starter aftercooler and air receiver.

VERY EXCELLENT — ON FOUNDATION

**For any size or make compressor try American Air.*

AMERICAN AIR COMPRESSOR CORPORATION

Dell Ave. & Power St. North Bergen, N. J.
UNion 5-4848

Circle 517 on Reader Service Card

CONVERSION & POWER EQUIPMENT

M-G SETS—3 Ph. 60 Cy.

Qu.	KW	Make	RPM	DC Volts	AC Volts
1	4000/4800	G.E. (3U)	450	250/300	2300/4600
1	2500	Whse. (3U)	720	600	2300/4600
1	1750/2100	G.E.	514	250/300	2300/4600
1	2000	G.E.	514	600	2300/4600
1	1500	G.E.	720	600	6600/12500
1	1500	Cr.-Wh.	720	600	2300/4100
-	1250	Whse.	720	600	2300/4100
1	1000	G.E.	720	250	2300/4100
1	1000	G.E.	900	250	4600/8000
1	500	G.E.	900	125/250	440
1	500	G.E.	900	250	2300/4600
1	500	G.E. (new)	1200	300	2300
1	400	C.W. (3U)	1200	125/250	2300
1	250	G.E.	900	125	440/4160
2	300	G.E.	1200	250	2300
1	300	Whse.	1200	600	2300/4160
1	200	G.E.	1200	250/275	440
1	200	G.E.	1200	250/275	2300/4160

MERCURY ARC RECTIFIERS

Qu	KW	Make	Type	DC Volts	AC Volts
1	150	G.E.	RF 20	245	208
1	150	G.E.	GRP	275	2300/4160

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	5000	G.E.	60/50/60	11000/6600
1	2500	G.E.	25/62½	2300/2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
2	2222	Whse.	OISC	1	13800x2000
1	3000	A.C.	OISC	3	34500x2300
3	1000	G.E.	OISC	1	13800x440
3	833	A.C.	OISC		13200x2300

TURBO GENERATORS

Qu.	KW	Make	Description
1	1000	G.E.	Non Cond. 125#/3-15# B.P. 2200V.
1	3000	G.E.	Cond. 400#-750° 3600/4150V.
1	4000	G.E.	Cond. 400#-750° 2400/4150V.

A.C. MOTORS — 3 Ph. 60 Cy. Slip Ring

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-378BS	4600/2400	1800
1	1500	G.E.	MT-8	4000/6900	1187
1	800	Whse.	CW	550	1775
1	800	G.E.	MT-428	2250	450
1	600	Whse.	CW-22D-15	440	1775
1	600	Whse.	CW	440	850
1	550	Whse.	CW	440	885
(Unused)					

SQUIRREL CAGE

1	550/275	Whse.	CR-1115	2300	450/900
1	500	G.E.	PT-550Y	2300	3600
2	350	Whse.	CSP-583H	440	3500
4	500	Whse.	CR-1216	2300	900
2	450	Elliott	3910	2300	1185
1	400	Whse.	CS-7151 4000/6600		3600
1	300	Whse.	CR-1005	2300	600
1	300	G.E.	KT-559A	2300	1775

SYNCHRONOUS

1	7000	G.E.	TS-6487	2300/4000	300
1	3500	G.E.	ATI	2300/6600	600
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

RE-HU-BILT BY

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Tel: OLDFIELD 3-3334

Circle 518 on Reader Service Card

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCB	3	7200/6600-4160/3400
2	750	G.E.	K	1	4800-120/240
1	600	Perma.	(Askarel)	3	12470Y/7200-240
3	250	G.E.	H Pyranol	1	4800/2530Y/120/240
3	200	G.E.	HSP27	1	2400/4160-240/480
3	500	Amer.	CC	1	4160/7200-240/480
3	75	G.E.	EP	1	2400/4160-120/240
3	50	G.E.	H	1	2400/4160-240/120
1	50	Amer.	Absetal	3	4160-120/208Y
4	25	West.	Hypersil	1	2400/4160-120/240
6	25	G.E.	Dry	1	2300-440

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 230Y.
1	75	G.E.	1200	125	2300/4160 Syn.
1	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4160 Syn.
1	200	G.E.	1200	250	2300/4160Y SR
1	200	G.E.	1200	250	440 Syn.
1	300	Al.-Ch.	1200	125/250	Syn. 440Y.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480 —1200

1—Wisconsin Gas (Air) PE-9g 7.5 KVA Master 1 or 3/120—2200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	60	West.	600	CW	220/440
1	60	G.E.	1200	MT	220
1	60	G.E.	880	MT548	440
1	75	G.E.	690	IM	440
1	150	West.	1200	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1200	AY-RW	2300
1	250	West.	600	CW	440
1	250	West.	1200	CW	2300
1	450	West.	1200	CW-4-30-0,	220 or 440
1	500	G.E.	450	MT	2300
1	800	G.E.	1200	M369Z	2300/4160Y

D. C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	350	G.E.	1200	Pedestal
1	30	G.E.	1750	175 FR
1	30	West.	600/1400	HK-403543

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1200, Allis. Chalmers, 2700/4160Y
1—275 HP, 1120 RPM G.E. Type KT 559BS 2300Y
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300Y
2—150 HP, 1800 G.E. TEFC Rep. 220/440
1—100 HP, 1775 RPM G.E. KYPP-542 3 ph 60-440Y.
1— 75 HP, 3600 RPM Cont. WP 505—440Y Rep. P
1— 50 HP, 3500 Cont. Ex. Pr. 220/440

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Pum BL 2200 V.
125 HP 600 RPM G.E. Type TS 2300 V.
125 HP 900 RPM G.E. Type TS 4000 V.
150 HP 3600 RPM G.E. type TS Fr. 256T 2300 V.
150 HP 1800 RPM G.E. Type TS 230 V.
300 HP 720 RPM Elec. Machinery t.o.f.c. 2300 V.
335 HP 900 RPM West—2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.

FOR POWER
J. L. HEMPHILL & CO.

Circle 519 on Reader Service Card

TRANSFORMERS

1—10667 kva G.E. 3/60/69000/11500
1— 8667 kva Westinghouse 3/60/115.000Y/13750
1— 6000 kva G.E. 3/60000/2400/4160Y
1— 2000 kva Nia. Askarel, 3/13800/4160Y/2400
3— 1500 kva Wagner, 1/60 cy. 6600—2400/4160Y
5— 1000 kva Standard, 1/44000/2000
3— 1000 kva Standard, 1/60000/4160Y/2400
3— 1000 kva Standard, 1/34400/480
3— 833 Allis Chalmers 1/60/12,000-480
3— 333 kva G.E., 25 cy, 2400/4800—240/480
3— 200 kva Westinghouse, 4800—240x480
3— 100 kva G.E., 2400/4160Y—120x240
3— 75 kva G.E., 2400/4160Y—120x240
1— 50 kva WEST CSP, 4160/7200Y, 120/240

ERIE ELECTRIC CO., INC.
28 Mechanic St. Buffalo 2, N. Y.

Circle 520 on Reader Service Card

TRANSFORMERS

BOUGHT · SOLD · RENTED

REWOUND · RE-DESIGNED

MANUFACTURED

Ask for our Stock List

For Sale

3—2500 KVA G-E 69000—2300Y
3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800
3—1500 KVA G-E 69000—2300Y
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y

THE ELECTRIC SERVICE CO., 5322 Hetzel St., Cincinnati 27, Ohio
"America's Exclusive Independent Transformer Service Shop"

Circle 521 on Reader Service Card

NEW EQUIPMENT FROM THE UNCOMPLETED

BATTLESHIP U. S. S. KENTUCKY

Installed but never used
Built of finest materials

WESTINGHOUSE 1250 K.W. TURBO-GENERATORS

(4)—Westinghouse—440/3/60—850*—540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

MAIN CONDENSERS

Mfg. by Foster-Wheeler—23,500 sq. ft. cooling surface—40,500 GPM circulating water—total tubes 8,976, cr cupro-nickel, as follows: (550) each ¾" x 0.066 and (8416) each ⅝" x 0.049. Monel water boxes.

BOILERS
7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity: 210,000 lb.* steam/hr. ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

LARGE DEAERATING FEED HEATERS

Monel construction—spray type—capacity 480,000 lbs./hr.—vent condenser—single pass —heating surface 174 sq. ft.—all Monel construction.

GE HIGH AND LOW PRESSURE MAIN PROPELLING TURBINES

Will sell separately for testing, wind tunnel or similar work. (2) high pressure—24,400 HP—12 impulse stages—4909 RPM—working pressure 540 lbs.—825°F. (2) low pressure—28,600 HP — 3913 RPM — working pressure 49 lbs. steam—424°F—2-6 stages of impulse.

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313 E. Baltimore St., Baltimore 2, Md.
ELIGIN 5-5050 — LEXINGTON 9-1900

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1—Gardner-Denver air compressor, 445 cfm @ 100# pressure, 6 cylinder, 2-stage, 1932. Req. 100 HP.

2—B. Keeler 200 HP water-tube boilers, 100 psi, Stoker fired, 1945.

1—Babcock & Wilcox #32E coal pulverizer, air swept, 75 HP.

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MODERN GE RECTIFIERS

3/60/13,200 AC to 600V. DC

4—1000KW Mod. 6RC-45-CD6

2— 500KW Mod. 6RG-45-CH2

Six Tube Ignitron Pump Type

Full Automatic AC & DC Controls

Can be inspected on original locations now in 1948, still like new, actual photos are available, very low price for lot.

S. M. DAVIS
525 N. 20th, E. St. Louis, Ill.

Circle 524 on Reader Service Card

CHECK WITH WAGNER FIRST!

Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P.
OUR 54th YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
750	G.E.	Slipring	2300	514
700	Whse.	Slipring	2300/4000	1200
600	G.E.	Synch.	430	900
600	Elliott (2)	Sq. Cage	2300	1200
500	Allis Ch.	Slipring	2300/440	600
400	G.E.	Sq. Cage	440	1200
400	Whse.	Sq. Cage	2200	514
400	Marathon (3)	Sq. Cage	2300	3600
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	2300/4000	450
350	Br. Boveri b.b.	Sq. Cage	4800/440	720
350	G.E.	Sq. Cage	2300	1200
350	Allis Ch.	Slipring	2300/4000	600
350	G.E.	Slipring	220/440	900
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	220/440	514
250	G.E.	Sq. Cage	2300/440	1200
250	G.E.	Sq. Cage	2300/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E. TEFC	Sq. Cage	440	1200
250	Whse.	Sq. Cage	2300/440	900
250	Whse. (4)	Slipring	2300/440	900
200	G.E. b.b.	Sq. Cage	220/440	720
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	900
200	G.E.	Slipring	2300	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2300/440	720
150	Whse. XP	Sq. Cage	440	3600
150	G.E. (4)	Slipring	2300/440	900
150	G.E. (2)	Sq. Cage	2300/440	1800
150	Whse.	Slipring	220/440	1200
150	Whse.	Slipring	2300	450
150	G.E.	Sq. Cage	2300	900
125	A.C. TEFC	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. TEFC	Sq. Cage	2300	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	900
125	G.E. (2)	Slipring	220/440	514
125	Max. TEFC	Sq. Cage	220/440	1200
100	Al. Ch. TEFC	Sq. Cage	2300	1800
75	G.E. b.b. (2)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	CT-321	250/320	1200
200	Gen. Elec.	RC	250	1450
100	Delco b.b.	late	120/240	1200
75	Allis Ch. b.b.	ER-144L	125	1500
75	G.E. b.b.	CD	250	1750
60	Ideal	D	125	1150
60	G.E. b.b.	CD	600	1750
50	G.E. (2)	CD-1129	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (3)	RC-58	230	1150
200	Whse. b.b.	SK	250	327/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-310	230	320/1000
125	G.E.	CD-172	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
100	El. Dyn. b.b. (3)	30-S	230	450/1200
75/100	Whse.	SK-191	230	300/900
75	Whse.	SK-102	230	1150
60	Reliance b.b.	230-T	230	1750
60	G.E. TEFC b.b.	CD-125	230	1150
50	G.E.	KP-16	230	350/1000
50	Century new	DN-514	230	1150/1750
40	Whse.	SK-163	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
500	Whse. Synch.	2300/4000 AC	250 DC
300	Whse. (3)	2300/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
125	Whse.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	120/240 DC
80	Star b.b. Synch.	220/440 AC	250 DC
75	Whse. Synch.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
50	G.E. b.b. (3)	220/440 AC	250 DC
35	Reliance b.b.	220/440 AC	250 DC

Arthur Wagner Co. Certified
MO nroe 6-7409
1435 W. RANDOLPH ST.
CHICAGO 7, ILLINOIS

Circle 525 on Reader Service Card

MISS POWER EQUIPMENT SAYS,

"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed NEW and REBUILT MOTORS"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
500	L.A. B.B. Splash. 440 Volt	FX-1408	3600
500	G.E. S.B. Open	IK	1200
400	West. S.B. Drip	CSP-981	1800
400	L.A. B.B. Splash		1800
400	G.E. S.B. Open	IK	1200
400	G.E. S.B. Open	IK-178	900
400	West. S.B. Open	CS	900
350	West S.B. Drip	CS-22586H	1200
300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	G.E. S.B. Open	KT-561	720
300	West. S.B. Open	CS-1002	900
300	G.E. S.B. Open	IK	600
250	El. Dyn. TEFCBB	KNX	1800
250	G.E. S.B. Open	KT	1800
250	West. S.B. Splash	CS-575	1800
250	G.E. S.B. Open 2200 Volt	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	G.E. S.B. Drip	K-6825	1800
200	West. S.S.B. Open	CS-856	1800
200	West. S.B. Open	CS	1200

CASH FOR YOUR SURPLUS
SEND YOUR LIST TODAY! NEW & USED Electrical Equipment

200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-158	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	G.E. S.B. Open	IK	900
200	G.E. S.B. Open	K-8335	900
150	Wagner TEFCBB	5p6	1800
150	G.E. S.B. Drip	K-6324	1800
150	West. S.S.B. Open	CS-771-C	1800
150	Al. Chal. B.B. Open	AR	1800
150	West. S.B. Open 2200V	CS	1800
150	West. B.B. Drip	CS-772	1200
150	G.E. S.B. Open	KT	1200
150	Al. Chal. TEFCBB	AZ	900
150	F.M. B.B. Open	H-34A	900
150	G.E. S.B. Open	IK	900
150	L.A. B.B. Splash	FX-1368	900
150	G.E. S.B. Open	IK	720
150	West. S.S.B. Open	CS-576-C	600
125	G.E. TEFCBB	K	3600
125	Burke B.B. Open 440 Volt	N-505	3600
125	Reliance T.E.F.C. B.B.	AA-5084	1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	Al. Chal. B.B. Open	AR	1800
125	G.E. S.B. Open	KT-558	1200
125	G.E. S.B. Open	IK	1200

125	F.M. B.B. Open	H	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	Al Chal. T.E.F.C. B.B.	ARZ-823	3600
100	C.W. B.B. Open 2300 Volt	SC-443	3600
100	G.E. S.B. Open	KT-548	1800
100	G.E. B.B. Open	K-504	1800
100	Reliance B.B. Open New	AA-5084	1200
100	West. TEFCBB	CS-770	1200
100	G.E. S.B. Open	KT-547	1200
100	West. S.S.B. Open	CS-887	1200
100	Al. Chal. T.E.F.C. B.B. XP	28E9	900
100	F.M. B.B. Open	H256C	900
100	F.M. B.B. Open	H	720
100	F.M. B.B. Open	H	600
75	West. B.B. Open New	CS-444	3600
75	Master B.B. Splash	PA-505	1200
75	Reliance B.B. Splash	505	1200
75	F.M. B.B. Open	H	900
75	F.M. B.B. Open	H	600
60	West. TEFCBB	CS-445	3600
60	G.E. TEFCBB	KF-445	3600
60	L.A. TEFCBB-XP	EX-445	3600
60	L.A. TEFCBB	JX-445	3600
60	West. TEFCBB	CS-445	1800
60	Cent. TEFCBB	NP-504	1800

FREE CATALOG. This is a partial listing. We are continually changing our stock, and can fill your requirements at any time. Send for our free catalog. In Stock, fractional horsepower up to 500.

Motors, Control Equipment, AC and DC Generators, MG sets and transformers.
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Circle 526 on Reader Service Card

37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	4000/2300	G.E.	1200
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300	G.E.	TS	1800
100	2300/440	G.E.	ATI	720
300	440/220	G.E.	TS	450
300	2300/440	G.E.	TS	1200
200	440	G.E.	TS	900
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	600

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/440	G.E.	SEDP	1200
300	2300/4000	Cont'l.	Spl.-Prf.	720
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2300	G.E.	KT	1800
200	2200	Cont.	TEFC	3600
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
150	440/220	G.E.	TEFC	720
150	2300/440		KT	600
150	2300/440	G.E.	TEFC	3600
125	2300/440	G.E.	FT	1200
100(2)	4000/2300	L. Allis.	K	600
100	2300	Cont'l.	OX	1200
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1600 Amp., DA-50, Whse., 600 V., Air
1—600 Amp., Al. Chal., 15 KV. Outdoor
6—600 Amp., R. Smith, 7.5 KV, Sol. oper.
1—400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	860
40/75	230	G.E. (new)	CD	600/1500
90	230	G.E.	CD	1750
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input.. AC	Motor Type	Output V., DC
300	Whse.	4160/440	Syn.	250/125
150	G.E.	440/220	Syn.	250
125	G.E.	440/220	Aq. Co.	125
100	G.E.	2300/440	Syn.	250
75	Cr. Wh.	440/220	Aq. Co.	250/120
70	El. Dyn.	440	Aq. Co.	70
65	G. E. B	2300/440	Aq. Co.	250

TRANSFORMERS 60 Cy.

1—800 kva, Al Ch., 2400/4160Y—480 volts, 3 ph.
3—500 kva, G.E., 13800—240/480 V
3—200 kva, Allis, 13,800—2300 V
3—333 kva, G.E., 13,800—2400 V.
3—333 kva, G.E., 2400—240/120 V.
3—200 kva, G.E., 13,800—480 V
3—200 kva, G.E. 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—230 V.
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

3—37½ kva, 1800 R, 230 V 3/60, Cont'l., 6 cyl.

only partial listing

STEPHEN **HALL** & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

Circle 527 on Reader Service Card

NEW BOILERS FROM S.S. HAWAII

NEVER USED

8 B&W WATER TUBE BOILERS

With Separately Fired Superheaters

634 pounds working pressure—850° T.T.—6053 square feet generating surface. Capacity 158,000 pounds steam per hour. Capacity plus 20%—190,000 pounds steam per hour. Total dry weight 135,258 pounds. Units complete with burners, economizers, soot blowers, valves, controls, etc.

DIMENSIONS:

Overall width 11'
Height over drum 21'
Depth 15'

THE BOSTON METALS CO.
313 E. Baltimore St., Baltimore 2, Md.
ELGIN 5-5050 — LEXINGTON 9-1900

Circle 535 on Reader Service Card

DUAL FUEL DIESEL ENGINE GENERATOR UNITS

1050 KVA Nordberg supercharged dual fuel diesel engine generator unit 3 phase 60 cycle 2400 volts 327 RPM. New 1947—Excellent condition.

1250 KVA Worthington supercharged dual fuel diesel engine generator unit 3 phase 60 cycle 2400/600/480 volts 360 RPM. New 1949—Excellent condition.

1420 KVA Fairbanks Morse opposed piston diesel engine generator unit 3 phase 60 cycle 2400/4160/480 volts 720 RPM. New 1950—Excellent condition.

The above units are still installed and complete with all auxiliaries as in operation.

INTERNATIONAL POWER MACHINERY CO.
1612 Union Commerce Bldg. — MAin 1-9514
Cleveland 14, Ohio

Circle 528 on Reader Service Card

DIESEL ENGINE GENERATOR UNIT

575 HP, 600 RPM, Worthington Type DH-6 Diesel engine direct connected to 500 KVA—400 KW, 80% PF, 600 RPM, 3 phase 60 cycle, 240/139 volts Electric Machinery synchronous generator complete and equipped with exciter, switchboard with instruments, attached and unattached auxiliaries to the engine. Slightly used—practically new. Immediate delivery.

UTILITIES MACHINERY CORPORATION
1965 East Sixth Street, Cleveland 14, O.

Circle 531 on Reader Service Card

FOR SALE

675 HP COOPER-BESSEMER DUAL FUEL DIESEL-GAS. 500 KW. 3/60/2300V. COMPLETE.

1275 HP COOPER-BESSEMER DUAL FUEL DIESEL-GAS. 900 KW. 3/60/2300 V. NEW 1953.

3000 KW GE CURTIS CONDENSING TURBO. 400# ISP. 3/60/2300 VOLTS. BUILT 1930. COMPLETE. EXCELLENT.

WHISLER EQUIPMENT CO.
1908 Railway Exchange Building
St. Louis 1, Mo.

Circle 536 on Reader Service Card

CRANE TROLLEYS Used Good Condition
Two-Whiting-5 ton units, complete
Plus 1-new 50 H.P. Motor, wound rotor
1-new Drum and Gears
Trolley is 5'-6" gage with 50 H.P. Drum and 1.5 H.P. Travel Motors, Electric Brakes.
All or Part — Must Move — Available Inspection, Roslyn, N. Y.
FS-4130, POWER
Class. Adv. Div., P.O. Box 12, N. Y. 36, N. Y.

Circle 532 on Reader Service Card

NEW EQUIPMENT

PURCHASED NEW — NEVER USED

ERIE BOILER
- 225 PSIG, 40,000 Lbs. Steam per hour.
- 4 Hr. peak load 44,000 Lbs. Steam per hour.
- 526 H.P. 250 Lbs.

AMERICAN BLOWER—FORCED DRAFT FAN
- 12,900 CFM 55,000 Lbs. of air per hour, 1,750 RMP.
- Includes No. 12 Coppus steam turbine with speed reducer and flexible coupling.

DANIEL BLOWER—INDUCED DRAFT FAN
- Includes No. 16 Coppus steam turbine with speed reducer and flexible coupling.

MURRAY STEAM TURBINE
- 1,370 H.P. 5080 RMP.
- Designed for 1,400 ton York compressor.

GRAHAM SURFACE CONDENSOR & JET EJECTOR
- Surface condensor size 30-11, 1080 Sq. Ft. surface area.
- Shell side 25 PSI, Turbine side 125 PSI.
- Including accessories, two electric condensate pumps, one "Badger" expansion joint, Atwood Morrill "Relief Valve."

Individual and Dealer Inquiries Invited

Write: FS-4237, POWER
Class. Adv. Div. PO Box 12, N. Y. 36, N.Y.

Circle 548 on Reader Service Card

FOR SALE

1500 KW, 80% Power Factor, 3 phase, 60 cycle, 2300 volts, 3600 RPM, General Electric 5-stage noncondensing steam turbine generator unit, 375 PSIG, 700° FTT, 125# exhaust back pressure, complete with direct connected shaft exciter and switchgear. Excellent condition—available immediate delivery.

EUCLID ENGINEERING CORPORATION
909 National City East Sixth Building
Cleveland 14, Ohio

Circle 529 on Reader Service Card

FOR SALE
14 NEW TURBINES

4 horizontal, 10 vertical, Westinghouse
Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired.
Price reasonable.
Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volts. Used one year.

G. M. De ROSE
2457 WOODWARD AVE.
706 DONOVAN BLDG.
DETROIT 1, MICH.

Circle 533 on Reader Service Card

BOILERS

HI-PRESSURE
Complete Stock from 10-2,000 h.p.
Nation's largest inventory, New & Used
WABASH POWER EQUIPMENT CO.
9710 Stickle Blvd., Chicago (Stickle) Ill. OR 5-8118

Circle 530 on Reader Service Card

MOTORS • GENERATORS
TRANSFORMERS
NEW • REBUILT
ELECTRIC EQUIPMENT CO.
WORLD'S LARGEST INVENTORY
CALL COLLECT GL 3-6783
P.O. BOX 51 • ROCHESTER 1, N.Y.

Circle 534 on Reader Service Card

If there is anything you want
that other readers can supply
OR . . . something you don't want—
that other readers can use—
Advertise it in the
SEARCHLIGHT SECTION

OPPORTUNITIES!

In

New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list . . . to
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE
Two Rector St., New York 6, N. Y.

Circle 537 on Reader Service Card

POWER EQUIPMENT

6000 KW, G.E. Cond. Turbo-Generator 3/60, 2400 V, 3600 RPM, 200 PSI

5500 KW, G.E. N.C. Turbo-Generator 3/50, 2300 V, 3000 RPM 600 PSIG 650°TT, 150# B.P.

1500 KW, G.E. Cond. Extr. Turbo-Gen. 3/60, 2400 V, 3600 RPM 200/400 PSIG, 750°TT, 15# Extr.

1000 KW, Worth-Moore, Cond. Ext. Turbine, 3/60, 245/490V, 3600 RPM, 130-300# I.P., 10# Ext.

640 HP, B & W, Water Tube Boilers (4) 200# Sectional Header

1500 KW, West. Motor Generator Sets (2) 3/60, 2300/4600 Volts A.C.— 250 volts D.C., 514 RPM

BREW, WOLTMAN
& COMPANY, INC.
50 CHURCH ST., NEW YORK 7, N. Y.

Circle 538 on Reader Service Card

2500 KVA GENERAL ELECTRIC MASTER UNIT SUB STATION

Still in Original Crates Outdoor Type 3/60/ 13,800 V Primary 2400 V Secondary
Assembled in 3 sections as follows:

A. Incoming Line Section
1—cable selector switch
2—13,800V—35 AMCM cable
1—Auto blast interrupter switch type SE-5 with key lock coordinated with transformer secondary breaker.

B. Transformer Section
1—2500 KVA 3/60/13,800V Liquid filled, with Manual Tap Changer

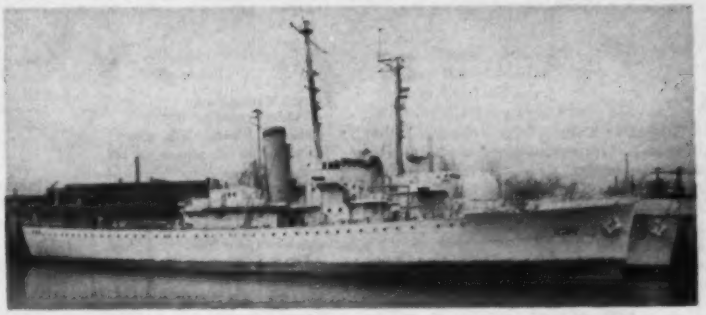
C. Outgoing Section
1—Control Panel & 10 KVA single phase 60 Cy. 2400/240/120V transformers for electric heaters & lights
4—Type AM 4.16.50 1200A Magnablast Air Circuit Breakers, Control panel contains 3 current transformers, ammeter and ammeter selector switch.

Cost $47,000.00

JOYCE EQUIPMENT CO., INC.
406-12 Ward Street
Chester, Pa.
PHONE: TRemont 4-8496

Circle 539 on Reader Service Card

FOR SALE: Turbo-Electric Vessel "TAMPA"



USE AS FLOATING POWER PLANT

or remove boilers and main turbo-generator for use as stationary power source

Power plant mfg by Westinghouse. Turbine: 3220 HP @ 3600 RPM—250 PSI—175° superheat — 28½" vacuum — 1½" back pressure. Water rate: 11.2 lbs/KW hr. Generator: 2600 KVA—2300 volts—3 phase 60 cycle—.8 PF—655 amps—3600 RPM—serial no. 4954746. Boilers: 2—B&W watertube—shop no. MB-1137—crossdrum sinuous header type. Total heating surface 3514 including superheater—WP 250 lbs—175° superheat. Oil burning; furnace volume 437 cu ft. Units complete with all auxiliaries such as fuel oil service pumps; oil heaters, etc. Also condenser & circulating pump; condensate pump; switch gear. All equipment in place. For immediate inspection.

The Boston Metals Company

313 E. Baltimore St. — LExington 9-1900 — Baltimore 2, Md.

Circle 540 on Reader Service Card

BOILERS

NEW UNASSEMBLED

# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Peinik-Loconti Industrial Supply, Inc.
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE 2-4513

Circle 541 on Reader Service Card

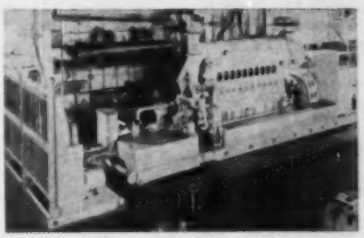
WANTED

Boiler parts, tubes and accessories that would go with above boilers. See above advertisement.

Peinik-Loconti Industrial Supply Inc.

Circle 542 on Reader Service Card

Portable diesel engine generator for peaking power



A 1000 kw portable power plant will supplement existing steam plant of the city of Norwalk, Ohio. Remanufactured by A. G. Schoonmaker Co., the portable plant with Fairbanks-Morse model 38D819 ten cylinder diesel engine was considered by city engineers the most efficient and economical for peaking purposes. Remanufactured diesel generators from 100 kw to 1000 kw are available for purchase, on short term lease, long term lease or on a lease-option arrangement for installation anywhere in the world.

A. G. SCHOONMAKER COMPANY, Inc.

Foot of Spring St., Sausalito, Calif.
EDgewater 2-1490

50 Church Street, New York 7, N. Y.
Digby 9-4350

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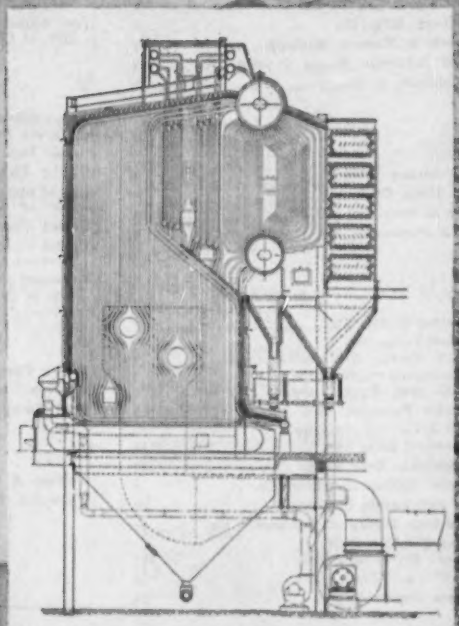
FUEL SAVINGS 16%



Longitudinal section of Union Type VO Steam Generator at City of Ames.

JOB: Includes delivering steam for a 12,650 KW Turbo-generator in Municipal Power Plant, City of Ames, Iowa.

STEAM GENERATOR: A Union Type VO Single-Pass (140,000 lbs./hr., 630 psi, 825° F). Fired by continuous ash discharge spreader stoker. Equipped with extended surface economizer for heat recovery. Selected for its adaptability to multi-fuel firing.

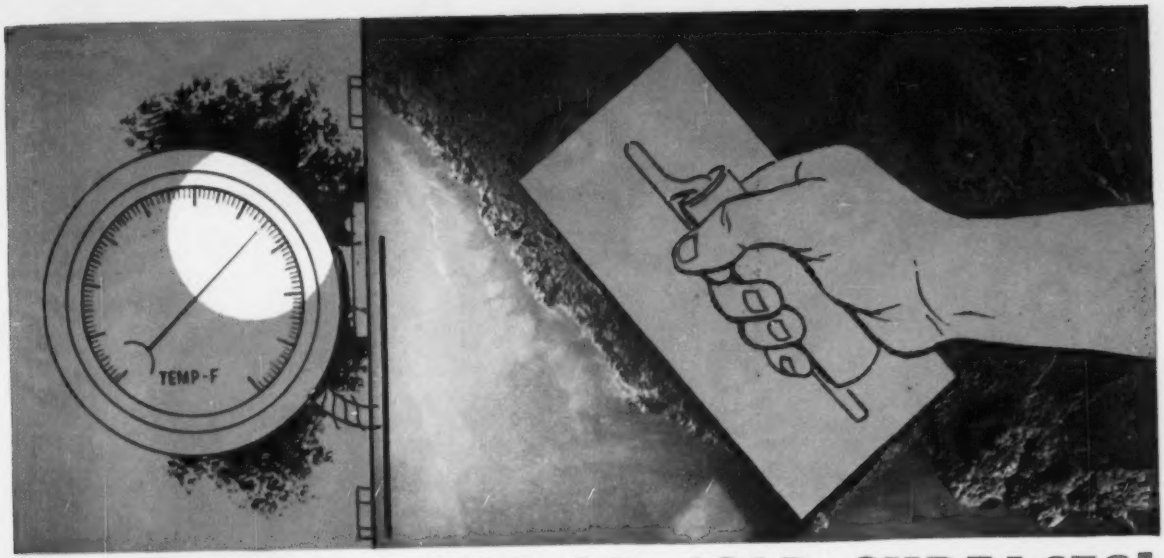
RESULTS: In continuous operation for six months, supplying total steam requirements, the Union VO was credited with fuel savings of 16%.

MORE INFORMATION: Many types and sizes of Union Steam Generators are described in illustrated Bulletin GB-959. Write: Union Iron Works, Erie, Pennsylvania.

UNION

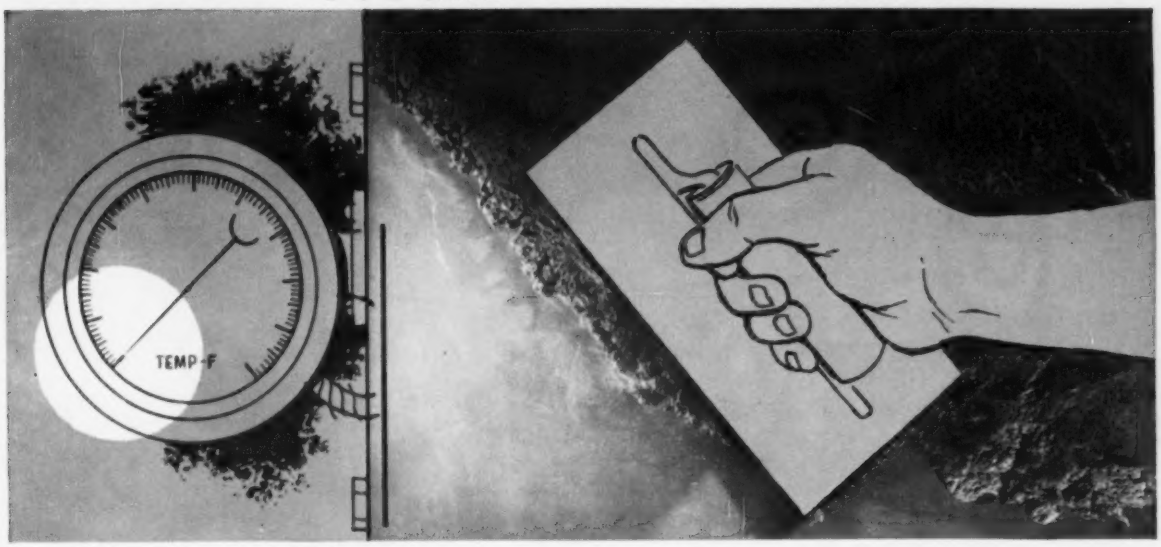
steam generators

For more facts circle 353 on Reader Service card, p 103



IT STICKS TO HOT OR COLD SURFACES!

. . . and it's rust inhibitive!



EAGLE-PICHER

SUPER "66"

INSULATING CEMENT

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

EAGLE EP PICHER

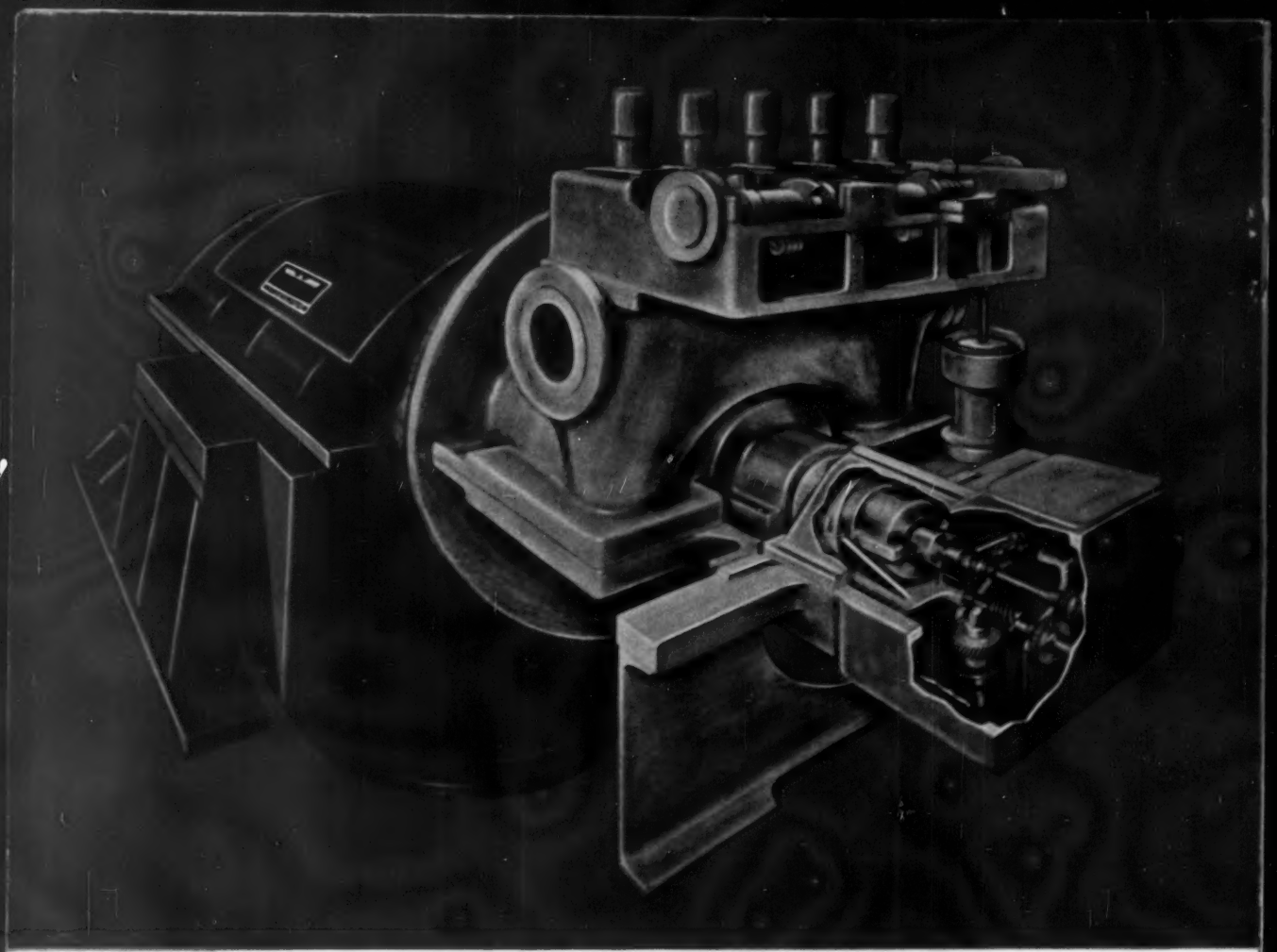
Since 1843

The Eagle-Picher Company
Dept. P-560
General Offices: Cincinnati 1, Ohio

Here's why you save money when you use Eagle-Picher Super "66" Insulating Cement

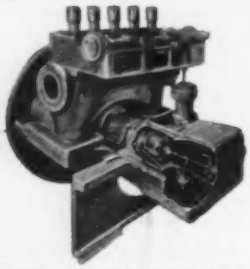
- Because it sticks, Super "66" saves time — applies quickly to any equipment, cold or hot. Effective up to 1800°F. . . . and it contains a special rust inhibitive which actually prevents corrosion !
- Because it sticks, Super "66" saves money— provides far greater coverage and more efficient insulation.
- Because it sticks, Super "66" makes difficult jobs easy—can be used on irregular shapes where application of other insulations is often impossible. Usually requires no reinforcing on applications up to 1½ inches thick.

For more facts circle 202 on Reader Service card, p 103

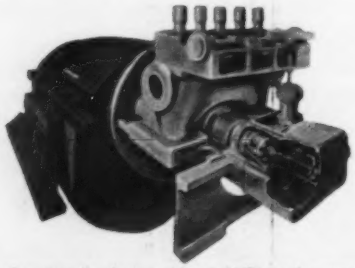


HOW WE ASSURE RELIABILITY IN A NEW DESIGN

1. Use an existing high-speed bearing case and a high capacity thrust bearing.



2. Add a high-pressure steam end of proved design with cam operated automatic nozzle control valves.



3. Complete the design with a multi-flow exhaust end.

HOW TO BUILD THE WORLD'S FASTEST 10,000 HP TURBINE

You can order this trail-blazing 15,000 rpm centrifugal compressor-drive turbine today with complete confidence because it makes use of components of proved reliability

Progress without sacrificing reliability is the goal of Worthington's Steam Turbine Division. How Worthington's creative engineering and advanced planning works to your advantage is illustrated by the steps taken in the continuing development of turbines of increasingly higher speeds:

1. Wherever possible use existing components proved reliable by years of operation.
2. Modify designs already in use in other high speed applications.
3. Thoroughly test these modifications to prove their reliability before field application.

Such advances in the turbine art bring new economies to high-speed, high-horsepower compressor drive applications. For information, call your nearest Worthington district office or write Worthington Corporation, Section 48-9, Wellsville, New York.

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